HANDBOOK

OF THE

HOSPITAL CORPS

UNITED STATES NAVY

1953

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FOREWORD

The Hospital Corps, United States Navy, has gained for itself a proud and unique position, in the 54 years since Congress established it as an organized unit of the Medical Department. The 25 charter members of the Corps, were they with us today, would glory in the accomplishments of their colleagues and successors, who now number more than 30,000. The memorable commendation by the late Secretary of the Navy, the Honorable James Forrestal, at the close of World War II, is but a single indication of a continuous record unmatched for outstanding service by any similar unit, past or present.

The technical competence and high morale of the Hospital Corps is based equally on the fine quality of personnel assigned to the Corps and on the careful training afforded each member. This begins in the basic and advanced corps schools, but is only fully effective if followed up by continuous study on the part of the individual corpsman. To be prepared to render the best possible aid to the sick and wounded, it is essential to continually develop new knowledge and skills and to keep abreast of all recent developments.

This Handbook of the Hospital Corps, 1953, is a lineal successor to a series of such books which began in 1914, but it is not strictly a new edition of any of them, being largely rewritten and containing much new material. It is officially approved as a textbook for the instruction of hospital corpsmen, not only of the Navy but of other Government services which may choose to use it. It is intended also to serve as a guide and reference book for all corpsmen, especially those on duty independent of a medical officer. The many naval officers and enlisted men who collaborated in producing this handbook deserve unstinted praise and congratulations on the quality of their product.

Lamont Pugh

LAMONT PUGH,
Rear Admiral (MC),
Surgeon General, U. S. Navy.

ACKNOWLEDGMENTS

The editorial board to compile and edit a new Handbook of the Hospital Corps of the United States Navy consisted of the following:

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TABLE OF CONTENTS

Chapter I

HISTORY OF THE HOSPITAL CORPS, UNITED STATES NAVY

A Commendation by the Secretary of the Navy

Out of Every 100 Men of the United States Navy and Marine Corps who were wounded in World War II, 97 recovered.

That is a record not equaled anywhere, any time.

Every individual who was thus saved from death, owes an everlasting debt to the Navy's Hospital Corps. The Navy is indebted to the Corps. The entire nation is its debtor, for thousands of citizens are living normal, constructive, happy and productive lives who, but for the skill and toil of the Hospital Corps, might be dead or disheartened by crippling invalidism.

So, to the 200,000 men and women of the Hospital Corps, I say in behalf of the United States Navy: "Well Done. Well done, indeed!"

Without your service, the Navy's Medical Corps could not have achieved the life-saving record and the mind-saving record its physicians and surgeons and psychiatrists achieved. That others might live, your fellow corpsmen have given their lives: 889 of them were killed or mortally wounded. Others died as heroically from diseases they were trying to combat. In all, the Corps' casualty list contains 1,724 names, an honor roll of special distinction because none among them bore arms.

The Hospital Corpsmen saved lives on all the beaches that the Marines stormed. Corpsmen were at the forefront of every invasion, in all the actions at sea, on all carrier decks. You were on your own in submarines and the smaller ships of the fleet, performing emergency surgery at times when you had to take the fearsome responsibility of trying to save a life by heroic means or see the patient die. Your presence at every post of danger gave immeasurable confidence to your comrades under arms. Their bravery was fortified by the knowledge that the Corpsmen, the sailors of solace, were literally at their sides with the skill and means to stanch wounds, allay pain and to carry them back, if need be, to safe shelter and the ministrations of the finest medical talent in the world.

You Corpsmen performed fox-hole surgery while shell fragments clipped your clothing, shattered the plasma bottles from which you poured new life into the wounded, and sniper's bullets were aimed at the brassards on your arms. On Iwo Jima, for example, the percentage of casualties among your Corps was greater than the proportion of losses among the Marines. Two of your colleagues who gave their lives in that historic battle were posthumously cited for the Medal of Honor. One of the citations reads: "By his great personal valor in saving others at the sacrifice of his own life (he) inspired his companions, although terrifically outnumbered, to launch a fiercely determined attack and repulse the enemy force." All that he had in his hands were the tools of mercy, yet he won a memorable victory at the cost of his life.

No wonder men and women are proud to wear the emblem of the Hospital Corps! It is a badge of mercy and valor, a token of unselfish service in the highest calling—the saving of life in the service of your country.

Your Corps' men and women toiled, often as dangerously, never less vitally, in areas remote from battle: In hospitals, on hospital ships, in airplanes, in laboratories and pharmacies and dispensaries. They helped, and are helping (for the task is far from over) in the salvage of men's broken bodies and minds that is the grim product and perennial aftermath of war. Some of you contributed toward new techniques in research and practice. Some used particular skills in dental technology, some engaged in pest control to diminish unfamiliar diseases, others taught natives of distant islands the benefits of modern hygiene, even to midwifery and everyday sanitation.

Scores of Corpsmen, made prisoners of war, used

their skill and strength to retain life and hope in their fellow captives through long years of imprisonment and deprivation.

Whatever their duty, wherever they were, the men and women of the Hospital Corps served the Navy and served humanity, with exemplary courage, sagacity and effort. The performance of their duty has been "in keeping with the highest traditions of the United States Naval Service." That, to a Navy man or woman, is the highest of praise. The Corps has earned it, and continues to earn it.

For, as I said, the task is not yet completed. Thousands of the war's casualties will long need the ministrations of physicians, nurses and the Hospital Corps before they can return to normal, peacetime pursuits. Hundreds may have to be cared for as long as they live; that these unfortunates are so few is in large measure due to the prompt, skillful aid accorded our wounded and stricken, by your Corps.

Illness and accident will add to these numbers, of course. There will always be the sick and the injured, and there will always be need for trained personnel to help restore them. The Navy's busy laboratories are forever engaging in research to combat disease, to speed the healing of torn flesh and broken bones, to devise new aids for the maimed to lead a normal life. And so I am impelled to address this message not only to the men and women of the Corps who have completed their service to the Navy, but to those who are presently in the Corps, and, also, to those who are joining—or re-joining—in that inspiring career.

It is no easy profession, even in peace time. There is danger in the test tubes and culture racks as menacing as in the guns of an unvanquished enemy. The Hospital Corps is never at peace. It is forever on the firing line in the ceaseless war against disease and premature death. That is why the Corps' emblem is truly "the red badge of courage," a designation to all the world that the person who wears it has been self-dedicated to the service of humanity.

Customarily the "Well done" signal is reserved for the closing phrase of a message of congratulation, but I placed it in the forefront where, in this instance, it most fittingly belongs. I repeat it, here, with the postscript that in earning its "well-done," the Hospital Corps is assured no other unit in the Navy did better in the degree of essential duty inspiringly performed.

(S) James Forrestal.

The above commendation was written by the Honorable James Forrestal, Secretary of the Navy, later the first Secretary of National Defense, at the close of World War II. Insofar as can be determined, this is the first time in military history that a single staff corps serving in so many diversified capacities, and scattered over so vast an area, has been commended by the Head of the Department.

During World War II, a total of 15 enlisted men of the Navy were awarded the Medal of Honor. Of this number, 7, or 46 percent of the total receiving this award were Hospital Corpsmen. The award of other personal medals, the Navy Cross, the Silver Star, the Bronze Star, etc., to the hospital corpsmen, has been by the tens and hundreds, almost too numerous to count. Wherever you find the hospital corpsman, the expression, especially in time of war, "Above and beyond the call of duty" is commonly heard.

What is the basis for the above? Why have so many members of the Corps been cited for performance of duty and for gallantly giving their lives in an attempt to save life? For a complete understanding of the *esprit de corps* of the Hospital Corps, it is necessary to regress and review the past upon which this corps has been built and the traditions which it has established.

From the very beginning of the Navy it was found necessary to make provisions for the care of the sick and injured. An act of Congress 1799, provided: "A convenient place shall be set apart for the sick and hurt men, to which they are to be removed, and some of the crew shall be appointed to attend them." That portion of the ship assigned for the care of the sick was designated as the cockpit. It was usually located in the forward part of the vessel, below the water line as a protection from shot and shell. The cockpit was also referred to as the "sick berth" and in later years it became known as the "sickbay," as the rounded shape of the recess or bay was located in the forward part of the ship between decks.

During the Revolutionary War period there were apparently no enlisted men trained in the care of the sick and injured. A number of the

least necessary members of the crew were assigned this duty. Most of the ships of this period, depending on size, carried a surgeon and a surgeon's mate.

In 1814, Navy Regulations referred to the "loblolly boy" who was to serve the surgeon and surgeon's mate. It was, among many others, the duty of the loblolly boy to go fore and aft the gun and berth decks ringing a small bell to give notice to "those slightly indisposed and with ulcers" to attend the surgeon at the mainmast. Both from old Navy Regulations and from authentic accounts of shipboard life of that day, the loblolly boy was before battle, to provide the cockpit with water, containers for amputated limbs, braziers of charcoal for heating the irons to sear the stumps caused by amputations, and for heating tar with which to stop hemorrhage. He was also to provide buckets of sand to catch the blood from amputations and wounds, and to pour over the blood on the decks so that the surgeon might not slip while working. Gruesome and crude? Yes. But the methods in use today may sound the same way to persons nearly 300 years from now. It must be remembered that the customary treatment for compound fractures of limbs at that time was usually amputation. During boarding of vessels, hand-to-hand combat with cutlasses, gun butts, clubs, and the use of cannon with round balls that did not explode, but were heated red hot before being fired, evidently resulted in many fractures which were eventually amputated.

The Bureau of Medicine and Surgery was established in 1842. An extract from a letter in this bureau dated 5 May 1843, reads as follows:

> A circular is now under consideration to allow a surgeon's steward to all hospitals and vessels, without necessity to sign articles, but to be appointed.

So far as can be determined, the surgeon's steward superseded the loblolly boy. The pay of the surgeon's steward is first listed as being $18 per month and one ration.

> A surgeon's steward is allowed at all hospitals and navy yards and on board every vessel having a medical officer. As it is important that a respectable class of persons should be employed in this capacity, surgeons will endeavor to select such as have some knowledge of pharmacy and ordinary accounts and are of industrious and temperate habits (Instructions for Medical Officers, U. S. Navy, 1857).

This was evidently the beginning of selection of specially qualified personnel.

In 1863 an order of the Navy Department allowed male nurses on receiving ships in number proportionate to the necessities of the case.

> Surgeon's stewards to rank next after master at arms (who was the leading petty officer of the vessel), and surgeon's stewards are never to be discharged without the consent of the officer appointing them or their successors, except by sentence of a court martial (U. S. Navy Regulations, 1865).

An order of the Navy Department dated 8 December 1866, reads in part:

> The designation of persons serving as surgeon's stewards is changed to that of Apothecary, and they will be appointed for duty in the Medical Department of the Navy, ashore and afloat, in the same manner as surgeon's stewards have heretofore been appointed.
>
> A candidate for examination and first enlistment as apothecary must be a graduate of some recognized college of pharmacy and must be between 21 and 28 years of age (U. S. Navy Regulations, 1896).

About the year 1873 the title of male nurse was changed to that of bayman.

> The surgeon's division shall consist of all junior medical officers of the ship, the apothecary, and the bayman.
>
> Baymen shall be given a course of instruction on board the receiving ship or at a naval hospital before being drafted for service on a seagoing ship.
>
> Baymen (formerly called nurses) are personal attendants on the sick (U. S. Navy Regulations, 1893).

From the above it can be seen that education and courses of instruction were necessary and this is believed to be the forerunner of the present Hospital Corps schools. It also indicates that the shore-sea billet rotation was established even at that early date.

Hospital Corps, Its Origin, 1898

The Hospital Corps came into existence as an organized unit of the Medical Department under the provisions of an act of Congress, approved 17 June 1898.

This act provided for appointment to the warrant rank of pharmacist, and established the following ratings:

(*a*) Hospital Steward (chief petty officer).

(b) Hospital Apprentice First Class (third class petty officer).

(*c*) Hospital Apprentice.

In accordance with this act, the Secretary of the Navy appointed 25 senior apothecaries of the

Navy as pharmacists. These original 25 are rightfully referred to as the charter members of the Hospital Corps. The dean of these was Cornelius O'Leary, who was credited at date of appointment with 37½ years of service as an apothecary.

In 1900, during the Boxer uprisings in China, the first member of the Hospital Corps was awarded the Medal of Honor. The citation reads in part: "Standley, Robert, Hospital Apprentice, U. S. N. in action with the relief expedition of the Allied Forces in China during the battles of 13, 20, 21, and 22 June 1900. Throughout this period and in the presence of the enemy, Standley distinguished himself by meritorious conduct." Standley retired from the Navy on 1 February 1939 with the rank of Chief Pharmacist and died on 15 July 1942.

An act of Congress, approved 22 August 1912, provided that pharmacists after 6 years from date of warrant and after satisfactorily passing prescribed examinations should be commissioned chief pharmacists.

The Hospital Corps was reorganized by an act of Congress approved 29 August 1916. This act is considered of sufficient importance to quote in part:

> Hereafter the authorized strength of the Hospital Corps of the Navy shall equal three and one-half percentum of the authorized enlisted strength of the Navy and Marine Corps, and shall be in addition, thereto, and as soon as the necessary transfers or appointments may be effected, the Hospital Corps of the United States Navy shall consist of the following ratings: Chief Pharmacists, Pharmacists, and enlisted men classified as Chief Pharmacist's Mates; Pharmacist's Mates, First Class; Pharmacist's Mates, Second Class; Pharmacist's Mates, Third Class; Hospital Apprentice, First Class; Hospital Apprentice, Second Class; such classifications in enlisted ratings to correspond respectively to the enlisted ratings, Seaman branch. * * * *Provided*, That enlisted men in other ratings in the Navy and in the Marine Corps shall be eligible for transfer to the Hospital Corps and men of that Corps to other ratings in the Navy and Marine Corps. * * * The Secretary of the Navy is hereby empowered to limit and fix the numbers in the various ratings. * * * and emoluments of enlisted men of the Hospital Corps shall be the same as are now, or may, hereafter, be allowed for respective corresponding ratings. * * * Hospital and ambulance service, with such commands and at such places as may be prescribed by the Secretary of the Navy, shall be performed by members of said Corps, and the Corps shall be a constituent part of the Medical Department of the Navy: * * *

During World War I, 10 of the 13 chief pharmacists were promoted to lieutenant (MC), U. S. N. During the war there were 94 temporary commissioned and warrant officers, and 16,000 enlisted men in the Hospital Corps.

During World War I, the reputation of the Hospital Corps for performance of duty, especially in the field with the Marine Corps, was greatly enhanced. Many of the members were cited for valor and performance of duty under fire, by both the United States and France.

In July 1922, all members of the corps holding temporary commissions or warrants were reverted to their respective permanent ranks or ratings.

From the period of World War I to World War II, the Hospital Corps became one of the outstanding corps of the military services. More schools were provided, qualifications for advancement in ratings were raised, and a high degree of technical skill and knowledge was demonstrated by all members of the corps.

Secretary of the Navy, the late Honorable James Forrestal, eloquently described the performance of duty of the Hospital Corps during World War II. No further eulogy, prose, or praise can better describe the corps and their actions during that period.

During World War II, women were first brought into the Hospital Corps. On 12 January 1944, the first Hospital Corps School for WAVES was commissioned at the U. S. Naval Hospital, National Naval Medical Center, Bethesda, Md. The first class consisted of 230 enlisted women.

Public Law 625 of the Eightieth Congress, approved 12 June 1948, made the WAVES an integral part of the Regular Navy.

Public Law 337, Eightieth Congress, approved 4 August 1947, established the Medical Service Corps. The law provides that the authorized strength of the Medical Service Corps shall be equal to 20 percent of the authorized strength of the Medical Corps of the Navy. It provides for commissioned grades of ensign to captain, inclusive. It consists of four sections: Allied science section, consisting of those holding degrees in sciences allied to medicine; pharmacy section, consisting of those holding degrees from schools of pharmacy; optometry section, consisting of those holding degrees from schools of optometry; and the supply and administrative section, consisting

generally of former pharmacists and chief pharmacists, chief and first class petty officers of the Hospital Corps. It is now possible for the hospital apprentice with diligence, study, effort, and conscientious application to duty to attain the rank of captain, Medical Service Corps.

On 2 April 1948, the nomenclature of the Hospital Corps ratings were changed to read: Hospital recruit; hospital apprentice; hospitalman; hospital corpsman third class; hospital corpsman second class; hospital corpsman first class; chief hospital corpsman; warrant officer and commissioned warrant officer, Hospital Corps.

At this time those hospital corpsmen who were classified as dental technicians, were changed to that rating. The rating structure outlines the dental ratings as follows: Dental recruit; dental apprentice; dentalman; dental technician, third class; dental technician, second class; dental technician, first class; chief dental technician.

Warrant and commissioned warrant officer, Hospital Corps, and Medical Service Corps officers (so qualified and assigned) perform administrative and technical duties in dental activities.

The rating insignia of the Hospital Corps was changed from the Red Cross, so long familiar, to the caduceus at this time. Dental technicians have the "D" superimposed over the caduceus.

The mission of the Hospital Corps is to give on land, sea, and in the air, intelligent, capable, and efficient assistance to Medical, Dental, Medical Service, Nurse, and Hospital Corps officers in the eternal war against disease, injury, and death, and to aid in maintaining the supply and administrative functions of the supportive branches of the Medical Department; in the absence of these officers, to display the knowledge and judgment required to meet all emergencies and in every possible manner assist to the best of their ability, training and knowledge in the function of the medical department of the Navy, i. e., *to keep as many men at as many guns as many days as possible*.

This complex mission requires from each member of the Hospital Corps a versatility neither demanded nor expected of other enlisted ratings in the navy.

Wherever you find the Navy, wherever you find the Marine Corps, there you will find the Navy Hospital Corpsman. In times of peace, he toils unceasingly, day and night, often in routine monotonous duties. In times of war, he is on the beaches with the Marines, is employed in amphibious operations, in transportation of wounded by air, in the front battle lines, on all types of ships, submarines, aircraft carriers, landing craft. In short, wherever medical service may be required, the hospital corpsman is there, not only willing but prepared to serve his country and his fellow man above and beyond the call of duty.

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Chapter II

ANATOMY AND PHYSIOLOGY

INTRODUCTION

Study of the Human Body

As a hospital corpsman, you must have a good basic knowledge of how the human body is constructed and how it works. This is known as anatomy (structure) and physiology (function). In your job of caring for the sick and injured, you will be constantly interested in the body. Just as a successful automobile mechanic knows the parts of his machine, the hospital corpsman must be familiar with the parts of the body and how each operates. Although such a knowledge will not cure patients, it is a basic tool needed for the successful treatment of disease and injury.

The human body is a combination of organ systems, with a supporting framework of muscles and bones and an external covering of skin. The smallest unit of life, the cell, is the building block of which all these organs and systems are made. The study of the body is divided into the following branches:

1. **Human anatomy** is the study of body structure and the relation of one part to another. Descriptive anatomy is a word picture of the character, form, and size of various parts of the body. Surgical anatomy deals with special features of those portions of the body that are important in the diagnosis and treatment of surgical diseases. Topographical anatomy is the study of the relationship of parts of the body to surrounding parts. Surface anatomy concerns the form and markings of the surface of the body. It helps in locating on a patient such parts as nerves or bones, which are hidden by the skin.

2. **Physiology** is the study of how the body works.

3. **Embryology** is the study of how the body developed from an ovum to its adult form.

4. **Histology** is the study of the minute form and appearance of normal cells and tissues, as seen with the aid of lenses or a microscope.

5. **Pathology** is the study of the changes in organs and tissues caused by disease.

6. **Biology** is the study of all forms of life. (Bio meaning life; logy, the study of.)

Classification of Living Matter

Everything in nature is either animal, vegetable, or mineral. Minerals are without life and are known as inorganic matter. Animals and vegetables, which possess life, are known as organic. This means that they are made up of materials that have been organized by life processes.

Any living thing, whether animal or vegetable, is an organism. The difference between them is that animals have sensation and power of voluntary movement, and require oxygen and organic food. Vegetables (plants) require only carbon dioxide and inorganic matter for food, and do not have voluntary movement or special sensory organs.

Actually, plants and animals live for each other. Animals need oxygen which plants give off, and they require plants for food, in order to obtain proteins, carbohydrates, and fats for building body cells. They exhale carbon dioxide and give off wastes, which are used by plants.

The way in which plants manufacture proteins, carbohydrates, and fats is interesting. When the rays of the sun strike the green chlorophyll in the leaves of the plant, carbon dioxide from the air and solutions of mineral salts from the soil are combined to form these organic materials, freeing oxygen to give back to the air.

Animals eat food containing organic materials and after digesting and absorbing them either

convert them into body cells or burn them, with the aid of oxygen inhaled into the lungs, to produce energy. In the process, waste products are formed; some are excreted by the bowels and kidneys while others, mainly carbon dioxide, are exhaled from the lungs.

Animals are classified in various major divisions. Those with a backbone or a notocord, including fishes, reptiles, birds, and mammalia, are called vertebrates. Man belongs to the order of mammalia (those that nourish their young with milk), and is unique in having the power of articulate speech and ability to reason abstractly. Man is also known as a human being and it is his life processes that we will be studying in this chapter.

Characteristics of Living Matter

All animal and plant life has certain chemical processes by which life is sustained and cells regenerated. These processes, from the time food enters the mouth until it is made into tissues to repair the body or is burned to provide energy, are called metabolism. Metabolism involves the absorption, storage, and use of food for the growth and repair of body tissues. It also involves the combination of foods with oxygen to make energy, and the final elimination of waste materials. It is the burning of foods that supplies the energy for carrying on all the body processes and that maintains body temperature in warm-blooded animals.

Another characteristic of living matter is that it is irritable and excitable. It responds to stimulation. Even a one-celled animal will move away when stuck with a pin, and you are all familiar with how you respond when this happens. Your nerves carry the impulse to your brain and your brain sends a message to your muscle to contract; thus you have an example of irritability and excitability.

Living matter is also able to move and to reproduce. Nonliving matter cannot. When all vital functions stop and metabolism ceases, the organism is dead.

The Cell

All living cells are composed of a viscid, jelly-like substance called protoplasm. Upon it depend all the vital functions of nutrition, secretion, growth, reproduction, irritability, and movement. Actually, protoplasm has in it the secret of life itself.

A typical cell is made up of a cell wall, cytoplasm, nucleus, and nucleolus. The simplest living organisms consist of a single cell. Yeast and bacteria are one-celled plants; the amoeba is a one-celled animal. The single cell of such a one-celled organism must be able to carry on all the processes necessary for maintaining life. This

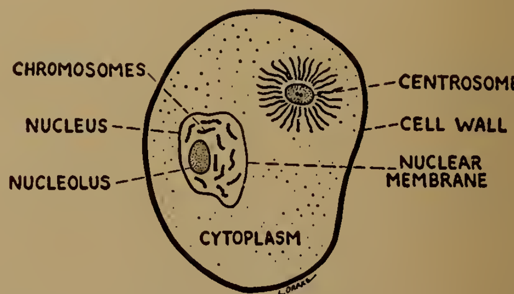

Figure 1.—Simple Cell.

type of cell is called a simple or undifferentiated cell.

In multicelled organisms, cells vary in their size, shape, and number of nuclei. When stained, other differences can be seen under a microscope. Many cells are highly specialized. Specialized cells are those that perform a special function, such as muscle cells which contract, and epithelial cells of the skin which protect. A mass of specialized cells that are similar in structure and function is called a tissue. An organ is a group of different kinds of tissues combined to form a part of the body having a special function.

One characteristic of cells is that they have a permeable cell wall through which fluids may pass. This is important because all body cells are bathed in tissue fluid from which they get the nourishment essential for life and growth. From the tissue fluid they absorb such things as oxygen, proteins, carbohydrates, salts, and water.

Cells may be irritated and excited to activity by mechanical, chemical, or nervous stimulation. This produces muscular movements, or secretions such as the digestive juices of the stomach. The stimuli are carried to the cell by nerves, or are caused by chemical substances that reach the cell through the blood and tissue fluid.

Tissues

Tissues, which are groups of specialized cells similar in structure and function, are classified in five main groups:

1. **Epithelial.**—The free surface of the skin; and linings of the digestive, respiratory, and urinary tracts, of blood and lymph vessels, of serous cavities, and of tubules of such secreting glands as the liver and kidneys.
2. **Connective tissue.**—The supporting tissue of the body, such as fat in meshlike cells under the skin, or cartilage in joints.
3. **Muscular tissue.**—Voluntary muscle fibers moving the skeleton; involuntary muscle fibers in the heart, blood vessels, stomach, intestine, and other organs.
4. **Blood and lymph.**
5. **Nervous tissue.**—The brain, spinal cord, and nerves.

If you look at some of these tissues under a microscope, you will see that the cells of different tissues differ widely. Muscle cells are comparatively large and shaped like long, slender rods; red blood cells are small, flat disks; and skin cells look like irregular blocks or scales. (See illustrations.)

There are two kinds of muscle tissues in the body:

1. Voluntary, or striated, which you can control by your will, such as the biceps muscle in your arm.
2. Involuntary, or unstriated, over which you have no control by your will, such as the muscle of your stomach. (Heart muscle, composed of a special branched type of cell, is involuntary, although it is striated.)

Muscles, which are formed of cells bound together in bundles, are capable of being stretched and of contracting when stimulated.

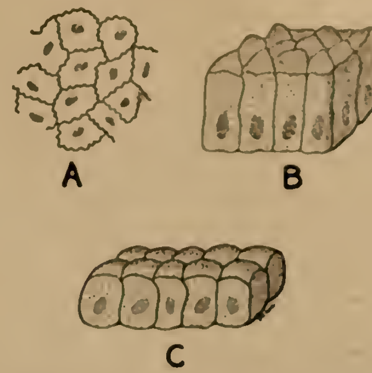

Figure 2.—Epithelial Tissue. A—Simple squamous; B—Columnar; C—Cubodial.

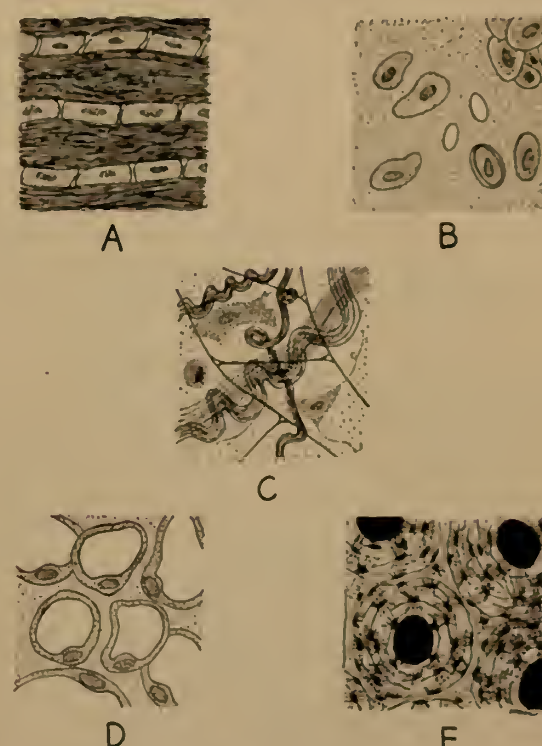

Figure 3.—Types of Tissue. A—Collagenous connective (Tendon); B—Cartilagenous; C—Connective (Aerolar); D—Lymphatic, E—Bone.

Figure 4.—Muscle Tissue. A—Voluntary; B—Involuntary; C—Cardiac.

Blood and lymph, though not actual tissues, may be considered as tissues consisting of free flowing cells in body fluids or the blood stream.

Nerve tissue is composed of nerve cells, nerve fibers, and supporting tissue between the cells and fibers, which keeps them in their position. It is the most highly specialized tissue in the body, requiring oxygen and nutrition to a higher degree than any other body tissue.

In the body, cells are the smallest building blocks. Groups of cells form tissues, and similar tissues form organs such as the heart, liver, and kidney. These organs are grouped together to form systems such as the urinary system, which is composed of the kidneys, the ureters (tubes from the kidney to the bladder), the bladder, and the urethra.

Anatomical Terms

To assist in describing the body, certain anatomical terms are used, and for determining position and direction you should be familiar with the anatomical position of the body.

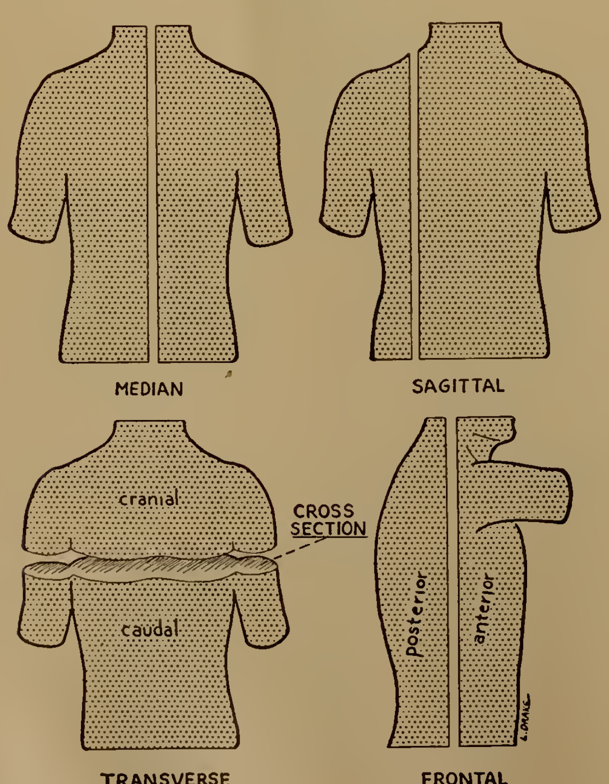

Figure 5.—Anatomical Planes.

The anatomical position is with the arms hanging to the sides, the palms of the hands facing forward, and the body in an erect standing position. Here are terms with which you should be familiar:

Anterior—toward the front or ventral side of body.

Posterior—toward the back or dorsal side of body.

Medial—nearer or toward the midline.

Lateral—farther from the midline.

Internal—inside.

External—outside.

Proximal—nearer the point of origin or closer to the body.

Distal—away from the point of origin or away from the body.

Superior—above.

Inferior—below.

Cranial—toward the head.

Caudal—toward the lower end of the body.

For convenience in describing the body and positions often used in placing a patient in bed or preparing him for a surgical operation, you should know the following anatomical postures:

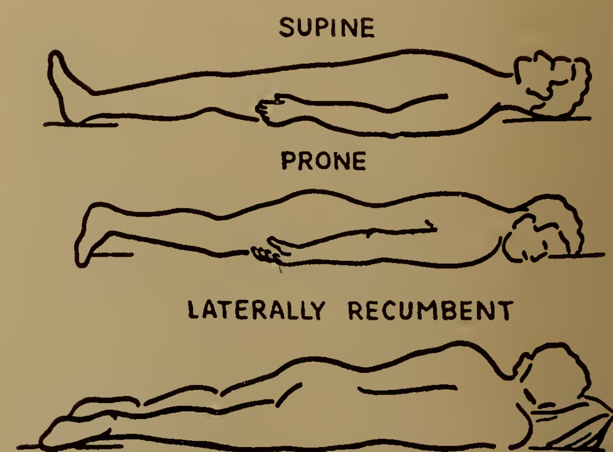

Figure 6.—Anatomical Postures.

Erect—the normal standing position of the body.

Supine—lying position of the body, face up.

Prone—lying position of the body, face and trunk down.

Lateral Recumbent—lying position of the body on either the right or left side.

THE SKELETAL SYSTEM

The Skeleton

The skeleton is the bony framework of the body. This framework is to support and give shape to the body, to protect vital organs, to afford attachments for tendons, muscles, and ligaments, and to act as joined members by which muscle movement is made possible.

Bones

Osteology (osteo meaning bone, logy study of) is the study of structure of bones. It also includes the study of cartilages and ligaments which bind bones together.

Bones are made up of calcium, phosphorus, and other mineral salts, and an organic substance called ossein. If you will take a human bone and soak it in dilute acid until all the inorganic mineral salts are washed out, you would have left only a perfectly flexible piece of tissue which could be bent and twisted without difficulty. So bone depends on inorganic mineral salts such as calcium and phosphorus for its strength and hardness.

Bone structure consists of a hard outer shell, and an inner spongy and porous center. The center is called a medullary canal and contains the

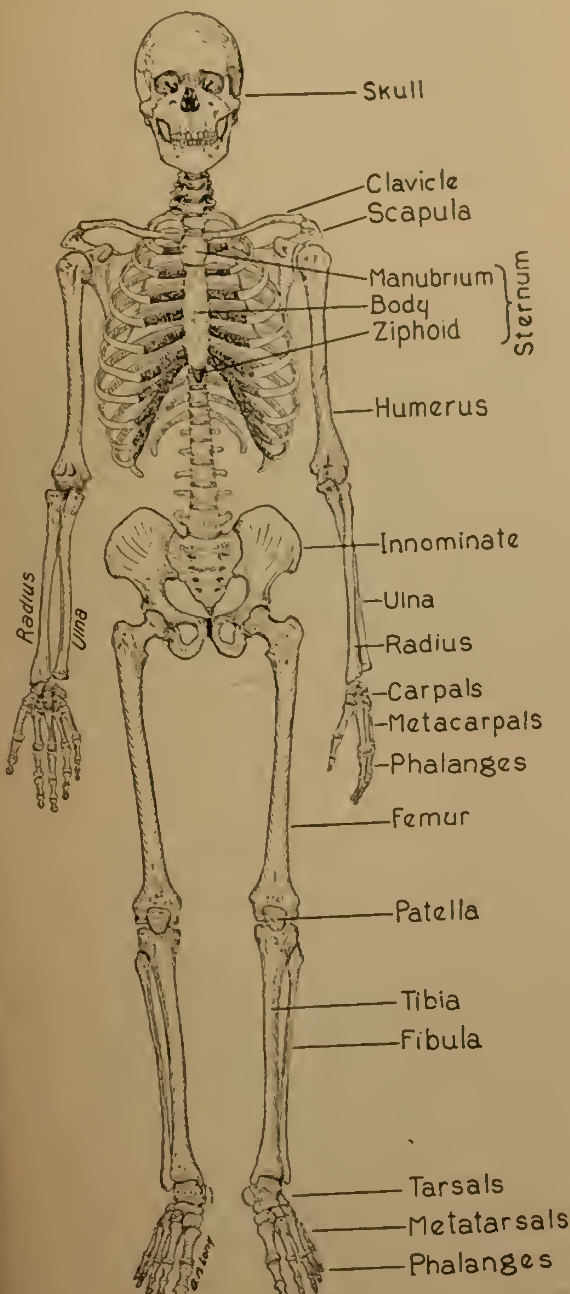

Figure 7.—The Human Skeleton.

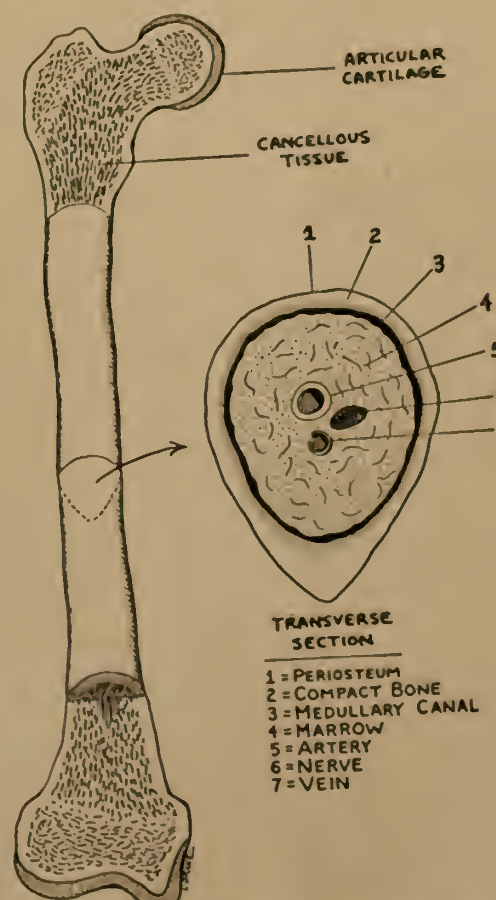

Figure 8.—Structure of a Typical Long Bone.

marrow. There are two types of marrow, red and yellow. Yellow marrow is chiefly fat; red marrow is where red blood cells are made.

At the end of the bones is a smooth glossy tissue to form the joint spaces; this is called articular cartilage (articular since one bone articulates with another or fits into another). The outer thin membrane of bone is called periosteum. The periosteum is important in nourishing the bone with blood. Capillaries and blood vessels run in the periosteum and dip into the bone surface to supply the bone with blood. The periosteum also has highly sensitive nerves which make it the pain center of the bone. In cases of fractures it is the periosteum that gives the pain, not the bone itself, and it is from the periosteum that new bone is formed.

Composition of bone.—Bone is both hard and elastic. Two-thirds of the bone is mineral matter (lime salts), to give it hardness. One-third is organic matter, which contains gelatin and gives the bone elasticity. A child's bones contain more animal matter, so they are more flexible and do not break so readily. As age increases, however, the proportion of mineral matter increases and bones become more brittle.

Classification of bones.—Bones are classified by shape as:

Long bones—examples: the femur and the humerus.

Short bones—bones of the wrists and ankles.

Flat bones—the skull, the sternum, the shoulder blades, and the pelvic bones.

Irregular bones—the vertebrae, the mandible, and the hyoid.

Number of bones.—There are 206 different bones in a human skeleton.

In a child there are more, but in later life some of the bones fuse together.

THE SKULL

The skull is the bony framework encasing the brain. It is divided into two parts, the cranium and the face.

It is made up of 23 bones, 8 of which form the cranium and 15 the face.

Cranial bones.—These bones are firmly united and fit snugly together. The lines between the bones where the adjacent bones meet are called

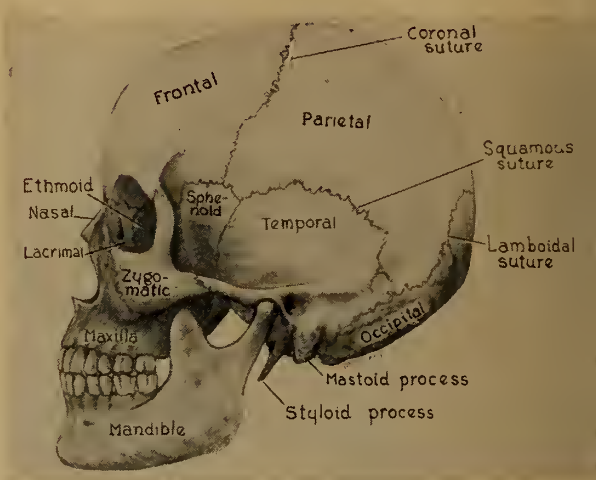

Figure 9.—Skull, Lateral View.

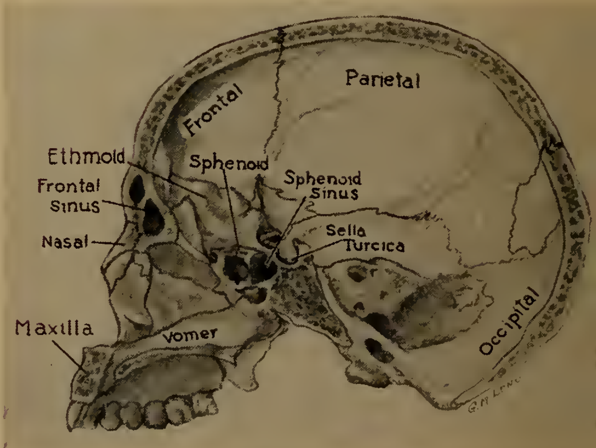

Figure 10.—Skull, Mid-Sagittal View.

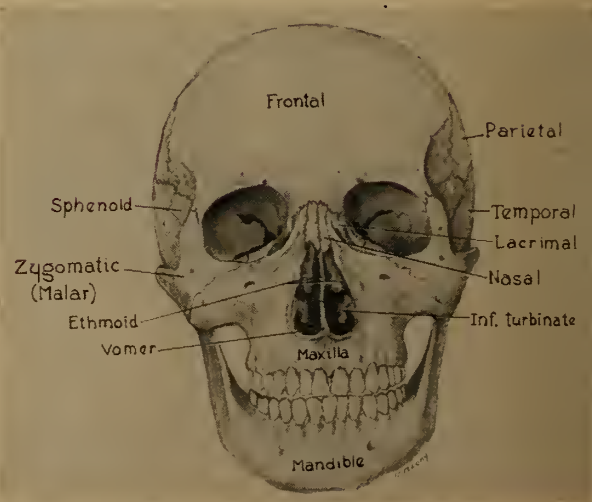

Figure 11.—Skull, Frontal View.

sutures. The most important bones for you to know are the frontal bone which forms the forehead, contains the frontal sinuses, and helps to form the eyesocket and nasal cavity; the two parietal bones which form the roof of the skull on each side; and the occipital bone which forms the back or base of the skull. This bone has a large hole in it called the foramen magnum, which permits passage of the spinal cord from the cranium into the spine.

Facial bones.—Of the 15 bones in the face, the ones that you should know are the two maxillary bones which form the upper jaw and the walls of the nose. In each of these is a large cavity called the maxillary sinus. These sinuses are important in the upper respiratory diseases. They frequently are infected following a common cold. The maxilli form the upper jaws as well. The mandible is a loose bone which forms the lower jaw. It is shaped something like a horseshoe and is the only bone in the skull that is movable. This, of course, is necessary for chewing.

THE VERTEBRAL COLUMN

The vertebral column, or spinal column, consists of 24 movable or true vertebrae, the sacrum, and

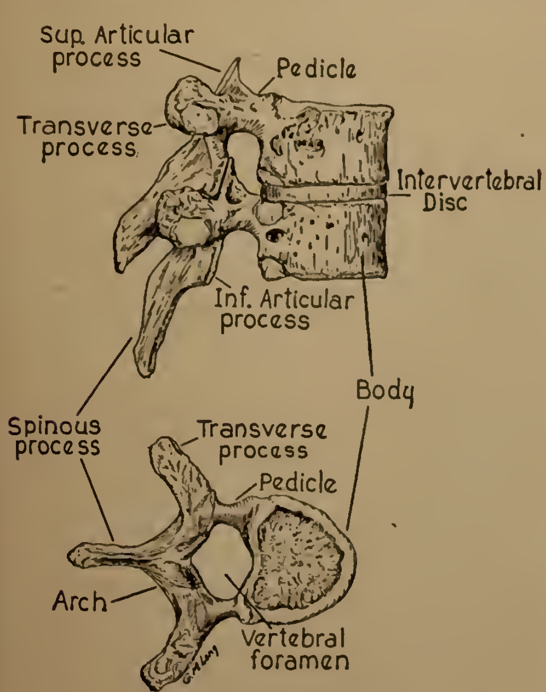

Figure 12.—Typical Vertebra.

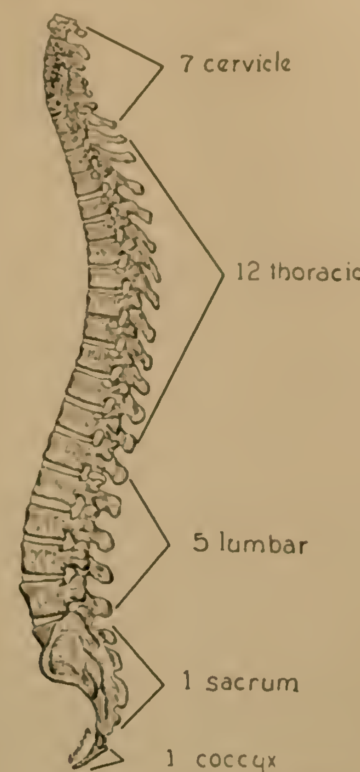

Figure 13.—The Vertebral Column.

the coccyx or tail bone. The spinal column is divided into five regions: cervical (neck), thoracic (chest), lumbar (lower back), sacral, and coccygeal (both in the pelvis). See figures 12 and 13.

Classification of vertebrae.—The vertebrae are designed to serve as a bony protection for the spinal cord and the nerves which arise from the spinal cord. Each vertebra has a compact body, which is the large solid segment of the bone in front. This body is for support, not only for the spinal cord but for the other organs of the body as well. Many of the main muscles of man are attached to the vertebrae. The hollow space or hole directly behind the body is for the spinal cord, and the various facets and processes are to help the vertebrae to move one on the other and for the attachment of the spinal muscles.

There are seven *cervical* vertebrae in the neck. The first is called the atlas because it supports the head. The second is the axis, as it is the one upon which the head turns. These are the only named vertebrae; all others are numbered. The seventh cervical vertebra has an especially prominent pro-

jection which can easily be felt at the nape of the neck. This makes it possible for doctors to count and identify the vertebrae above and below it.

There are 12 vertebrae in the chest region. These articulate with the ribs to form the back wall of the chest cage.

There are five lumbar vertebrae. The sacrum is roughly triangular in shape and is formed by the fusion of five false vertebrae. The sacrum articulates on each side with the hip bone, and with the coccyx forms the posterior wall of the pelvis.

THE THORAX

The thorax is a cone-shaped bony cage formed by the sternum or breast bone and grouped cartilages in front, 12 ribs on each side, and the bodies of the twelve thoracic vertebrae behind. It houses the heart and lungs, vital organs of circulation and respiration.

The sternum occupies the middle of the upper part of the chest wall in front. It is attached to the clavicles (collar bones) and the cartilages of the first seven ribs.

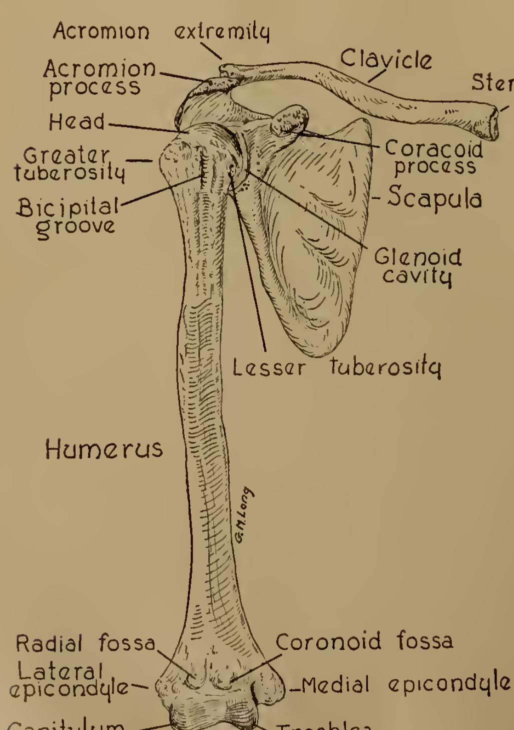

Figure 14.—The Shoulder Girdle.

There are 12 pairs of ribs, which form a series of curved bones that support the chest wall. Behind they articulate with the thoracic vertebrae. In front each rib is provided with cartilage. The first seven ribs are attached to the sternum and so are called true ribs. The eighth, ninth, and tenth ribs are united by their cartilages to the cartilage of the seventh rib and are called false ribs. The last two ribs are free in front and are called floating ribs.

THE UPPER EXTREMITY

The upper extremity consists of the shoulder, the arm, the forearm, the wrist, and the hand. The bones that form the framework for the upper extremity are the clavicle, the scapula (shoulder blade), the humerus (arm bone), the radius and ulna (forearm bones), the carpus (wrist bones), the metacarpus (bones of the palm), and the phalanges (finger bones). See figures 14 and 15.

Clavicle.—The clavicle forms the front part of the shoulder girdle. It lies in a horizontal position just above the first rib and is shaped like a flat letter **S**. Because of its location and because it is close to the skin, the clavicle is often fractured as the result of falls.

Scapula.—The scapula is a triangular shaped bone (see illustration). Its outer corner helps to form the shoulder joint, articulating with the humerus.

Humerus.—The humerus extends from the shoulder to the elbow. It is made up of a head, an anatomical neck, a surgical neck, a shaft, and a distal extremity. The head articulates with the scapula. The distal end articulates with the radius and the ulna.

Radius and ulna.—When the arm is in anatomical position with the palm facing forward, the radius is on the lateral or thumb side and the ulna is on the medial or little finger side. When the hand is pronated (palm down), the bones rotate on each other and cross in the middle. This makes it possible for you to turn your wrist and hand in opening doors and unscrewing bottles. The ulna joins the humerus and articulates with the radius at both ends. The radius articulates

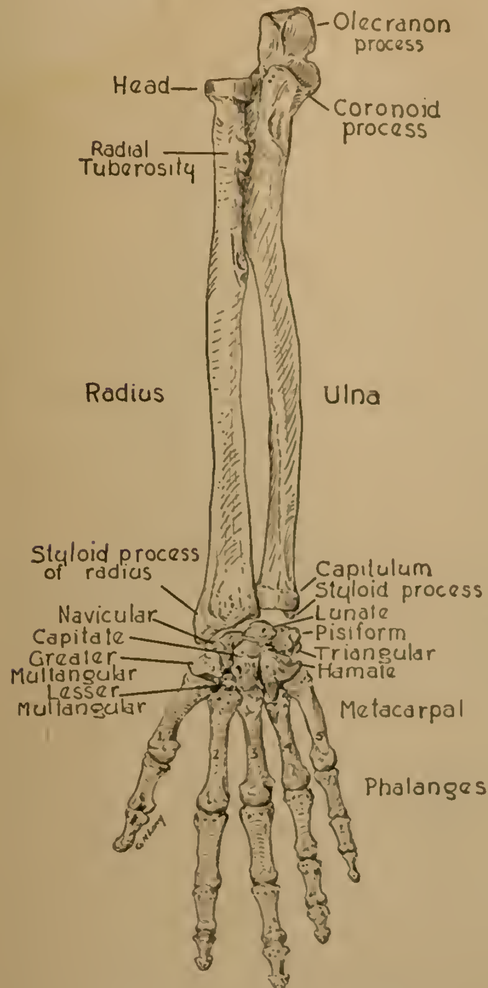

Figure 15.—The Forearm and Hand.

with the humerus and with the ulna at both ends and with some of the carpal bones. It helps form the elbow, and the two bones can be felt at the wrist, the radius on thumb side and the ulna on the side of the little finger.

Carpal bones.—There are eight carpal bones arranged in two rows.

Metacarpal bones.—These are numbered one to five to correspond with the five fingers and the phalanges with which they articulate.

Phalanges.—These are the small bones of the fingers. Each finger has three bones, except the thumb which has two. The bone at the end of the finger is called the distal phalanx, the one closest to the hand the proximal phalanx, and the one in between, the middle phalanx.

THE LOWER EXTREMITY

The lower extremity includes the hip, thigh, leg, ankle, and foot. The bones that make up the framework for the lower extremity are the innominate or pelvic bone (hip bone), femur (thigh bone), patella (knee cap), tibia and fibula (leg bones), tarsals (ankle bones), metatarsals (foot bones), and phalanges (toe bones).

Innominate bone.—An innominate bone has three parts, the ilium, the ischium, and pubis. The upper edge of the ilium is important anatomically because it helps to locate important surface anatomy points. For example, there is a bony projection called the anterior superior spine of the ilium. This is the point at the front of the hip bone and is helpful in locating the appendix, for the appendix is midway between that point and the navel. The acetabulum is a cup-shaped structure on the outside of the hip bone in which is seated the ball-like head of the femur. The two innominate bones, together with the sacrum and the coccyx in the rear, form what is known as the pelvic girdle. It is a deep basin designed to protect the organs of the lower abdomen, especially the bladder, lower bowel, and reproductive organs.

Femur.—This is the longest bone in the body and, like other long bones, is made up of a shaft and two ends. The upper end is rounded and has a head which fits into the acetabulum. It also has a neck, the part of the femur most frequently fractured, and two processes for attachment of muscles, called the lesser and greater trochanters. At the lower end are two bony prominences called the lateral and medial condyles. These articulate with the tibia and the patella.

Patella.—This is a small oval-shaped bone overlying the knee joint. It is enclosed within the tendon of the quadriceps muscle of the thigh. Bones like the patella that develop within a tendon are known as *sesamoid* bones.

Tibia.—This is the larger of the two leg bones and lies on the medial side. Its upper end articulates with the femur and with the fibula. Its lower end articulates with the talus (one of the bones of the foot) and also with the fibula. A prominence easily felt on the inner side of the ankle is called the medial malleolus.

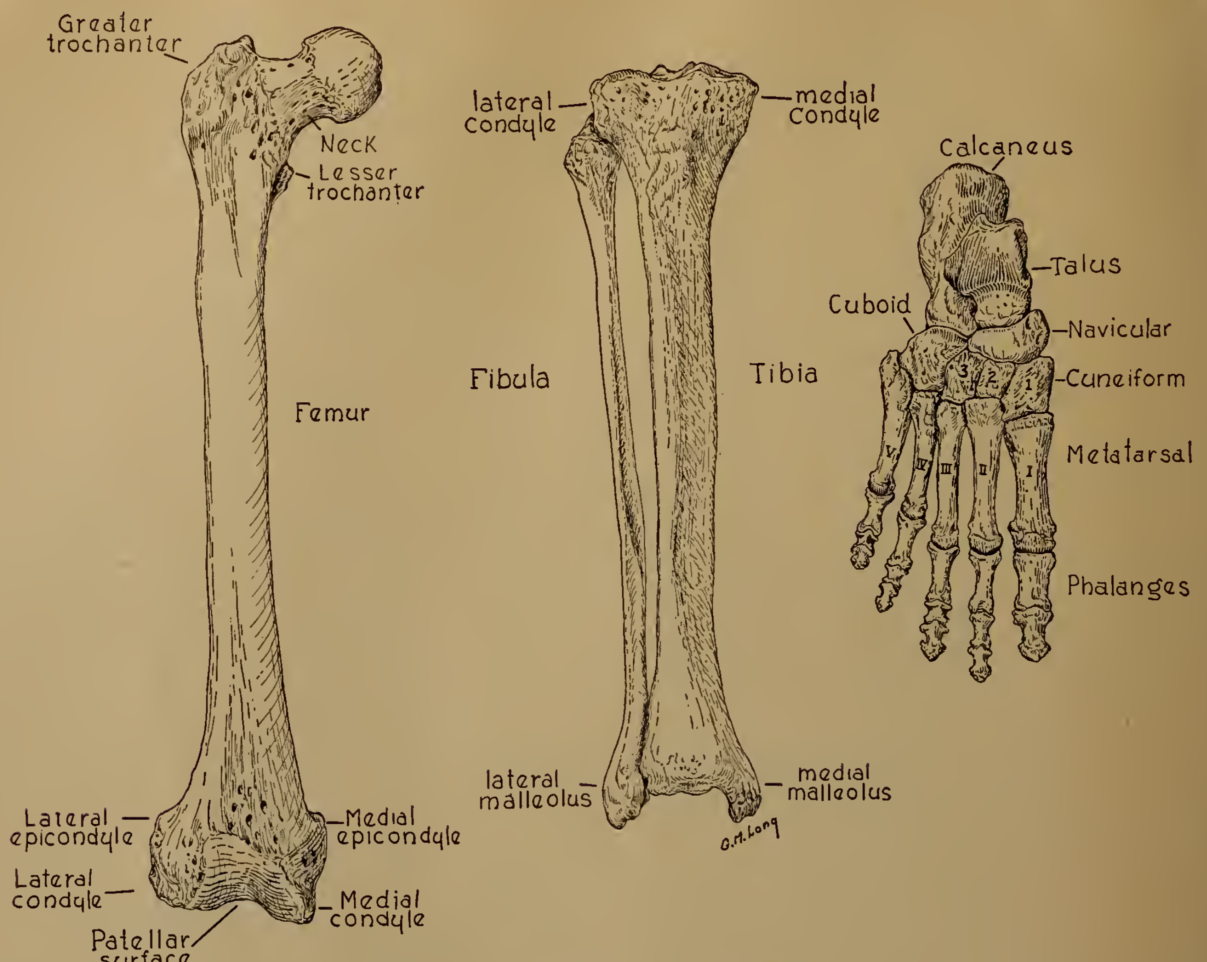

Figure 16.—The Bones of the Lower Extremity.

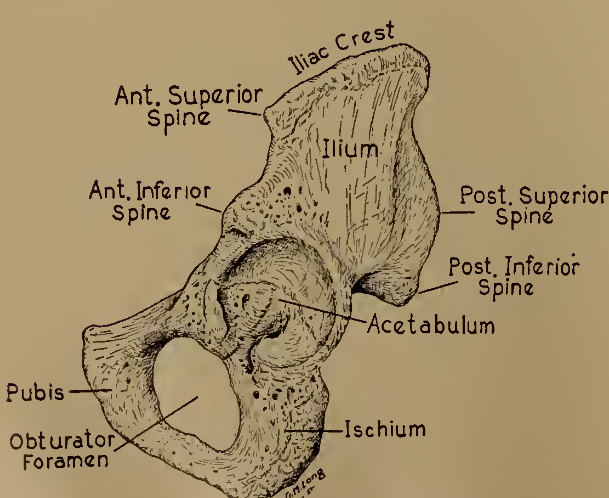

Figure 17.—The Innominate Bone, Lateral View.

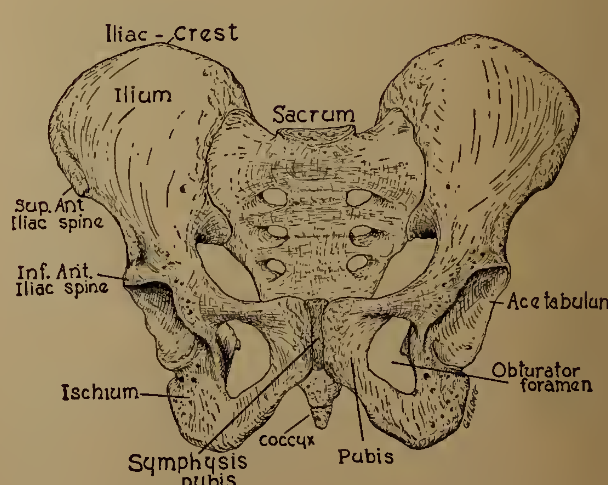

Figure 18.—The Pelvic Girdle.

Fibula.—This is on the outer side of the leg. The prominent portion of the lower end of the bone is called the lateral malleolus. It can be felt beneath the skin and helps form the ankle joint.

Ankle.—There are seven tarsal bones that form the ankle. The calcaneus is the name for the heel bone.

Foot.—Forming the sole and instep of the foot are the five *metatarsals*. These are similar in arrangement to the metacarpal bones of the hand.

Phalanges.—These are similar in number, structure, and arrangement to those in the fingers.

JOINTS

Wherever two bones are attached to each other, a joint is formed. In a freely movable joint such as the knee joint or elbow joint, the ends of the bones are covered with a smooth layer of cartilage. The whole joint is enclosed in a watertight sac of membrane, containing a small amount of lubricating fluid. This enables the joint to work with little friction. The function of ligaments, which reach across the joints from one bone to another, is to keep them from getting out of place. When ligaments are accidentally torn, we call the injury a sprain; when bones get out of place, there is a dislocation. When the bones are broken or chipped, the injury is called a fracture. The different types of joints in the body are:

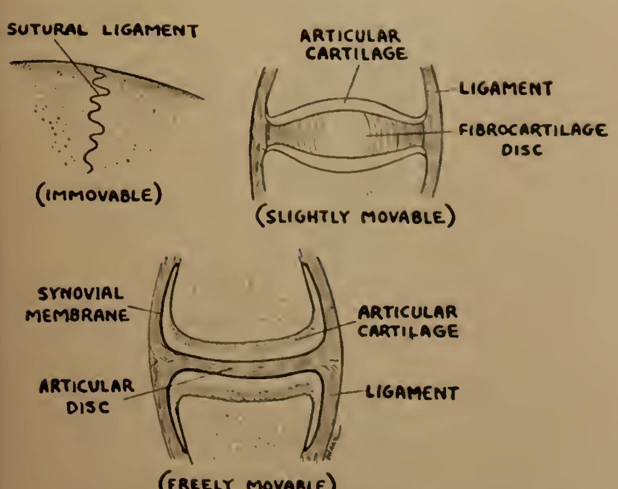

Figure 19.—Typical Joints (After Grays Anatomy).

Immovable.—Bones of the skull, which are rigidly interlocked along lines that are called sutures.

Slightly movable joints.—As seen between the vertebrae and in the symphysis pubis, where the bones are held together by broad flattened discs of cartilage and by ligaments.

Freely movable joints.—Such as the knee, shoulder, hip, and elbow. Included under the movable joints are hinge joints—elbow and knee; ball and socket joints—shoulder and hip; gliding joints—wrist and ankle; pivot or rotary joints—the axis rotation about the atlas; condyloid joints (in which an oval head of one bone fits into the shallow depression of another)—the metacarpophalangeal joints.

Joint movements are of several types:

1. *Flexion*—bending the forearm on the arm, the leg on the thigh, or the fingers on the palm of the hand.

2. *Extension*—straightening or unbending, as in straightening the forearm, leg, or fingers.

3. *Abduction*—moving an extremity away from the body, as in abducting the arm.

4. *Adduction*—bringing an extremity toward the body, as in abducting the arm.

5. *Rotation*—turning the head.

6. *Pronation*—turning downward, as in placing the hand palm down.

7. *Supination*—turning upward, as in placing the hand palm up.

8. *Eversion*—turning outward. For example, turning the sole of the foot lateralward.

9. *Inversion*—turning inward; as in turning the sole of the foot inward.

MUSCLES

The study of muscles, myology, is important, since all human activity is carried on by muscles. One-half the weight of the human body is made up of muscles. A man has more than 500 muscles large enough to be seen by the unaided eye and many thousands so small that a microscope must be used to see them. Even if the body had no skin to cover it, most of the skeleton would be hidden

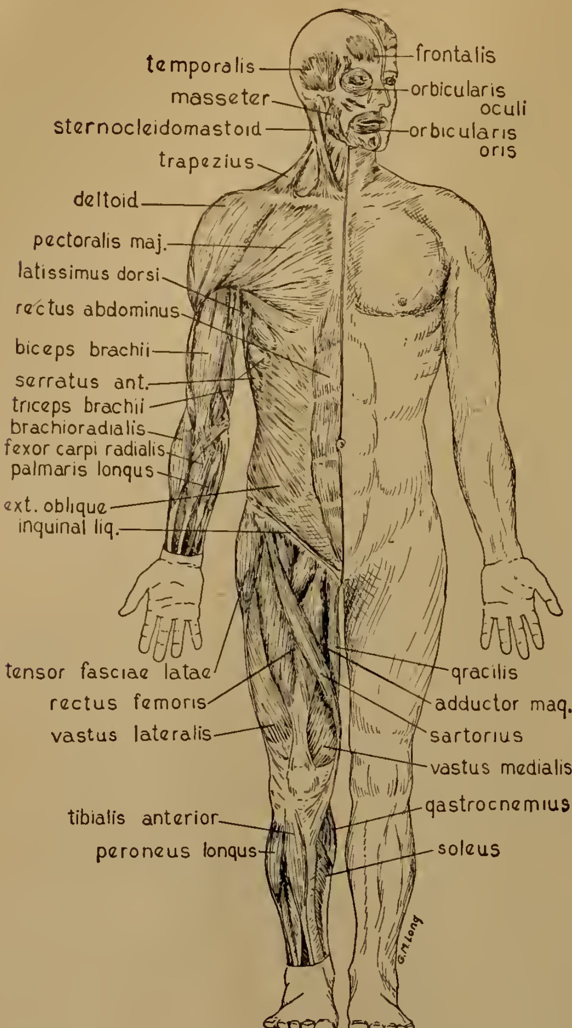

Figure 20.—Important Superficial Muscles, Anterior View.

by one or more layers of muscle. The form the body takes is due largely to the muscles covering the bones.

All body motions are produced by muscle action—even to making your hair stand on end, for cold or fright causes contraction of tiny muscles in the skin and makes the hair stand up. During your lifetime there is never a moment when all the muscles are quiet. Although you may be relaxed and resting, your heart is beating and your lungs are breathing and muscles are at work. The muscles in the heart, the stomach, the intestines, and the arteries are at work even though you are not aware of it.

Terms to Know

In studying muscles, you will need to know a few terms such as:

Muscle.—An organ to produce motion.

Tendon.—A thin, strong, white cord which connects muscle to bone. Tendons make it possible for muscles to apply their force at a considerable distance from their contracting part. For instance, many of the muscles that move the fingers and wrist are located in the upper part of the forearm. If it were not for long tendons in the wrist and fingers, these parts of the body would be thick and clumsy.

Ligament.—A strong band of tissue which holds bones together or organs in place.

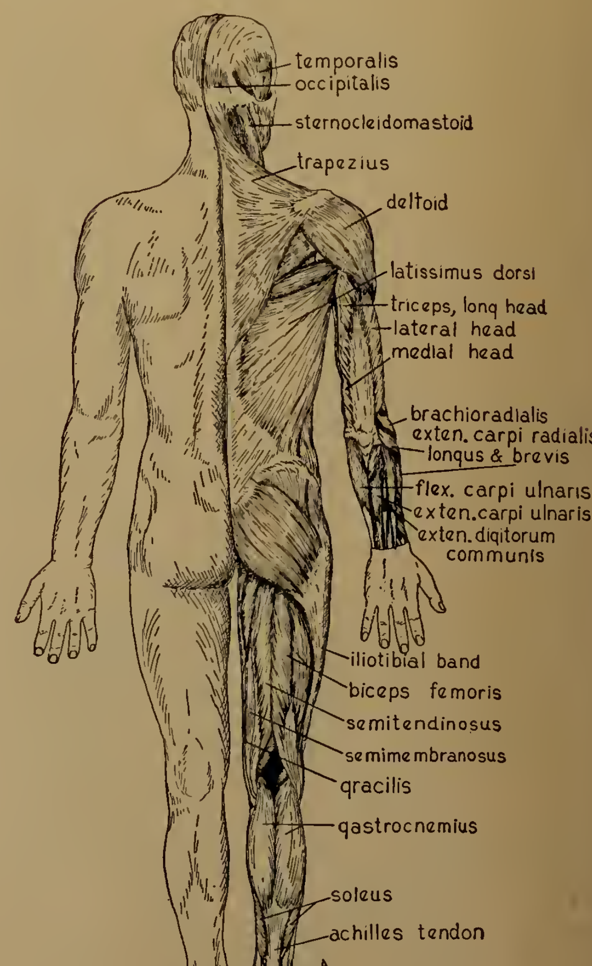

Figure 21.—Important Superficial Muscles, Posterior View.

Fascia.—Fibrous tissue surrounding muscles and keeping them in place during movement.

Origin.—The more fixed attachment of a muscle.

Insertion.—The more movable attachment of a muscle.

Fatigue is produced when the muscles have contracted repeatedly, and waste products have accumulated in the muscle cells.

A motor nerve is the nerve which causes a muscle to move.

Rigor mortis is the stiffening of muscles some time after death.

TWO TYPES OF MUSCLES

There are two kinds of muscles, depending on whether we control the muscle or it works automatically. The kind that works whether we wish it to or not is found in the heart, the stomach, the intestines, the arteries, and other organs. These are called involuntary muscles (cardiac and smooth muscles).

The other muscles, which work under our will, are found chiefly in the face, neck, limbs, and outer parts of the trunk, and attach to the skeleton. A man cannot by his own choice stop his heart from beating or start it if it stops, but he can move an arm or a leg. These muscles, which move the skeleton, are called voluntary, striated, or skeletal muscles.

In passing it is interesting to note that this is evidence that your Creator gives you life and operates your body automatically, but gives you the privilege of choosing what you will do with the muscles that you yourself can move. Your life depends on muscle action that you cannot control, while the kind of work you do in life depends on how you use the muscles you can control.

How Muscles Are Made

All muscles are made up of long, slender cells. When muscles work, these cells become shorter and thicker, and a similar change takes place in the whole muscle. For example, bend your forearm on your arm now and squeeze it tight; note how your biceps muscle thickens and gets hard. This is contraction of a voluntary muscle.

A typical skeletal, or voluntary, muscle is a fleshy mass of elongated muscle fibers held together in a casing of white fibrous tissue and supplied with a nerve which makes it work. These nerves are called motor nerves, since they send out impulses that actually start the muscle motor which makes the body move.

At one end of some muscles are long white tendons, something like guy wires, which extend to your fingers and your feet. This not only makes for graceful movements of your fingers, but also reduces the amount of bulk that would be necessary if muscles had to extend around your fingers.

Muscles seldom act alone, but usually in muscle groups, and these muscle groups are held together by white fibrous tissue called fascia.

When a muscle contracts it uses energy and does work. In the process it must have fuel in the form of sugar called glucose. Glucose is produced during the digestion of nearly all forms of starch or sugar, and it occurs naturally in many foods. After repeated contraction, muscle cells break down and must be replaced. The repair material for wornout muscle cells is protein, a substance that occurs in large amounts in meat, eggs, beans, milk, and similar foods.

When a muscle contracts it produces chemical waste products (carbon dioxide, lactic acid, and acid phosphate), which make the muscle more irritable. If contraction is continued the muscle will finally cramp up and refuse to move. This condition is known as fatigue. If it is carried too far, the muscle cells will not recover and permanent damage will result. Muscles, therefore, need rest to allow the blood to carry away the waste materials and bring in fresh glucose, oxygen, and protein to restore the muscle protoplasm and the energy that was used.

The importance of exercise for normal muscle activity is clear, but excessive muscle strain is damaging. For example, if a gasoline motor stands idle, it eventually becomes rusty and useless. Similarly a muscle cell that does not work becomes weak and flabby. On the other hand, a motor that is never allowed to stop and is forced to run too fast or do too much heavy

work soon wears out so that it can no longer be repaired. In the same way, a muscle cell that is forced to work too hard, without proper rest, will be damaged beyond repair. Violent exercise is never good. Exercise should be adapted to the individual and should never be carried to the point of extreme fatigue.

During exercise, massage, or performance of ordinary activities, the blood supply of muscles is increased. This brings in fresh food materials, carries away waste products more quickly, and enables the muscles to build up and restore their efficiency and tone.

When a muscle dies it becomes solid and rigid and no longer reacts. This stiffening, which occurs from ten minutes to seven hours after death, is called rigor mortis.

How Muscles Work

Muscles do three things for us:

1. Provide movement, as in peristalsis in the intestines.

2. Maintain our posture through muscle tone, as in the muscles of the head, neck, and shoulders, which keep the head erect.

3. Produce heat. Chemical changes that take place during muscle activity, such as mild exercise on cold days, keep us warm.

BURSAE

Bursae are small fluid-filled sacs which overlie joints where pressure may be exerted between the skin and the bone, between bone and tendons, and between muscles or ligaments and bones. Some of these frequently become inflamed. Among them are:

Subacromial bursa in the shoulder, located between the deltoid muscle and the head of the humerus.

Prepatellar bursa just below the kneecap. Inflammation here, with forming of fluid, is known as "housemaid's knee" because it occurs frequently in charwomen who mop floors while kneeling.

Olecranon bursa over the elbow. When inflamed, this is known as "student's elbow," because students frequently lean on their elbows and irritate this little fluid-filled sac.

SPECIAL MEMBRANES AND GLANDS

Membranes are the lining tissues of the body, and are serous, synovial, mucous, and cutaneous.

Serous membranes are so named because they are moistened by a fluid resembling the serum of blood. Serous membranes proper are found in fluid-filled sacs which cover the lungs, heart, organs contained in the abdominal cavity, brain, and spinal cord.

Synovial membranes are those lining joints and bursae. These, too, contain fluid.

Mucous membranes are those lining the inside cavities of the body, such as the mouth, intestines, lungs, bronchi, gallbladder, kidneys, and urinary bladder.

Cutaneous membrane is the outer covering of the body, the skin. This is the largest organ of the body and important for its protective function.

GLANDS

Glands secrete something essential to the body, or excrete waste materials which, if retained, might be injurious to the body.

There are simple glands such as the salivary glands, which secrete saliva into the mouth, and ductless glands that secrete hormones directly into the blood stream, their secretion not requiring a duct. The island cells of the pancreas, which make insulin, are examples of ductless glands.

THE BLOOD AND THE BLOOD VASCULAR SYSTEM

Blood is the fluid tissue that circulates through the blood vessels in the body, and blood, which the heart pumps rapidly round and round the body through miles of arteries, veins, and capillaries, does many things to keep us alive and healthy. It carries the necessities of life—oxygen, water, and food—to all the cells of the body. In an average adult weighing 160 pounds, the 6 quarts of blood in his body amount to about one-twelfth of his body weight.

Blood consists of plasma, red cells, white cells, and platelets. The cells flow freely in the clear fluid portion, blood plasma, which carries them to the body cells.

Blood enables the cells of the body to breathe by bringing them oxygen from the lungs and by carrying carbon dioxide from the cells back to the lungs, where it is expelled.

Blood carries food from the intestines to the body cells, and carries away waste products to kidneys or bowels, where they are removed from the body.

Blood furnishes water to the cell tissues.

Blood distributes heat produced by the working muscles; and because of its water content and mobility, blood serves as a temperature regulator for the body.

Actually blood serves as a conveyor belt to carry food, hormones, oxygen, and all the essential nutrients for life. In one sense the blood stream is a river of life, carrying food, water, and oxygen to the body cells. In the other direction the blood stream serves as a sewerage system, carrying away body wastes from the cells to the organs of excretion—the kidneys, bowels, lungs, and skin.

Blood also carries white blood cells and antibodies. The latter are complex chemical substances which serve as a constant bodyguard against infections and other diseases.

Your blood stream has its own repair system. If a blood vessel is ruptured, the blood platelets help to form a clot and stop the bleeding.

The blood stream, which is slightly alkaline, also has an important function in keeping the acid-base equilibrium or balance of the body.

Healthy blood (plasma and blood cells) is 78 percent water and 22 percent solids.

Blood plasma, the liquid portion of the blood, is a clear straw-colored liquid, slightly alkaline. Blood plasma, in contrast to blood serum, is the liquid part of blood before coagulation takes place. If blood escapes from its vessel, it usually coagulates or clots. As the clot forms it shrinks and squeezes out a clear, yellowish liquid known as blood serum. Blood serum may be defined as the liquid part of blood after coagulation takes place.

Lymph is the liquid plasma which has passed through the walls of capillaries into the tissues.

Under the microscope, blood is seen to contain cells suspended in a liquid, and these cells—red cells, white cells, platelets—comprise about 45 percent of the blood. The remaining liquid portion is the blood plasma, 90 to 92 percent of which is water and about 9 percent solids.

Under the microscope, red cells look like red discs or saucers with pale centers. They are usually all about the same size, in a healthy blood smear.

White cells are larger than red cells and have well-formed centers, or nuclei, the essential part of the cell.

Platelets are colorless cells with no nuclei, and vary greatly in size and shape.

ACID–BASE EQUILIBRIUM

The normal body processes result in acid end products which tend to make the blood less alkaline. Oxidation in all tissues produces carbon dioxide, which is acid; muscular contraction makes lactic acid; the oxidation of protein, which contains sulfur and phosphorus, produces sulfuric and phosphoric acids.

In spite of the formation of such acid substances in the blood, it remains remarkably uniform and slightly alkaline at all times. Variations in reactions greater than from pH 7.0 to 7.8 are almost never observed.

By some mysterious means the body maintains this acid-base balance by quickly neutralizing acids that are formed in the tissues and promptly eliminating them through the lungs or kidneys, or neutralizing the acids by substances in the blood called buffers. A buffer is any substance which tends to prevent the reaction of a solution from changing on the addition of acids or alkalies.

When this neutralizing mechanism is overtaxed by taking in too much acid or alkali or as a result of disease, there occurs a notable change in the blood reaction. The resulting conditions are known as acidosis or alkalosis. Any such change of reaction is fatal unless quickly corrected or compensated.

IMMUNITY

The body's defense against infection is called immunity. This is the body's ability to protect itself against injury by bacteria or poisonous bacterial products called toxins. In this defense the blood and lymph play an important role. The blood plasma carries antibodies which neutralize toxins and help knock out invading bacteria and

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viruses. The blood also contains white cells which serve as soldiers to kill enemy bacteria.

When a substance is injected into the body, it stimulates an opposing substance. The substance injected is called an antigen and the opposing material in the blood stream is called an antibody. Foreign substances such as bacteria and their toxins, when entering the bloodstream, act as antigens and stimulate the blood plasma to form specific antibodies. These antibodies are of several types, such as bacteriolysins which kill the bacteria themselves, agglutinins which cause bacteria to clot, precipitins which precipitate bacteria and antitoxins which neutralize bacterial poisons.

White blood cells, with their power of movement, surround bacteria and destroy them. In the fight, white blood cells themselves are destroyed, forming pus.

TRANSMISSION OF HORMONES

Hormones, the secretions of ductless glands, are internal secretions which enter directly into the blood stream. They are then carried to the parts of the body where their effect is produced. As a rule, the ductless glands are not located near the organs that their hormones affect, so their hormones are carried by the blood stream to the distant organs for their actions. By this distribution of the hormones throughout the blood stream, a harmonious coordination is accomplished in the body.

BLOOD COAGULATION

To protect the body from excessive blood loss, blood has its own power to coagulate or clot. Circulating blood will not clot, but upon escaping from the blood vessel it begins to clot immediately.

As soon as blood escapes from its vessel and strikes the air or the skin, a strange chemical reaction sets in. The clot formed is at first fluid but soon becomes thick and then "sets" into a soft jelly, which quickly becomes firm enough to act as a plug.

This plug is the result of a swift, sure mechanism which changes soluble blood protein, fibrinogen, into the insoluble protein, fibrin, whenever injury occurs.

Necessary elements for blood clotting are calcium salts, a substance called prothrombin formed in the liver, and blood platelets which break up to set off the clotting mechanism.

Once the fibrin plug is formed, it quickly enmeshes red and white blood cells and draws them together tightly. Blood serum, a yellowish clear liquid, is squeezed out of the clot as the mass shrinks.

Formation of the clot closes the wound and prevents blood loss. A clot also serves as a network for the growth of new tissue in the process of healing.

Normal clotting time is 3 to 5 minutes, but if any of the substances necessary for clotting are absent severe bleeding may occur.

Hemophilia is an inherited disease in which the patient's platelets are too tough to break up and set off the clotting mechanism, so blood clotting is delayed and even a trivial wound may cause severe and dangerous bleeding.

THE CELLS OF THE BLOOD

Red blood cells are circular red discs or saucers with pale centers and no nucleus, which are formed in the bone marrow. They are about $\frac{1}{3200}$ of an inch in diameter, and the adult male has about 5,000,000 per cubic millimeter of blood. The red color of red blood cells is due to hemoglobin, an iron-protein substance which combines with oxygen and carries it from the lungs to the body cells. Hemoglobin also has the power of readily combining with carbon dioxide and carrying it from the body cells to the lungs.

At a certain point in the development of the red cell, hemoglobin is added. This hemoglobin consist of iron-containing red pigment (heme) combined with a protein substance (globin). It is the hemoglobin that gives the red cells the ability to pick up oxygen in the lungs. Iron is a keystone raw material required by the red cell factories. Part of this "scrap iron" is salvaged from broken-down red cells; the rest comes from our food. If iron is lacking, the amount of hemoglobin in the red cells is lowered, and later the number of red cells in the blood stream is reduced. The best food sources of iron are meat (especially liver), eggs, green vegetables, and whole-grain bread and cereals.

Red blood cells live about 100 to 120 days in your body. When you think of the rugged life that a fragile little blood cell lives, there are reasons for its short life span. This delicate cell has to withstand constant knocking around as it is pumped into the arteries by the heart. It travels through blood vessels at high speed, bumps into other cells, bounces off the walls of arteries and veins, and squeezes through narrow passages; it must adjust to continual pressure changes. Fragments of red blood cells are found in the spleen and other body tissues. The spleen is the graveyard where old, wornout cells are removed from the blood stream.

In the oxygen-carbon dioxide exchange the red cells deliver oxygen to the tissues. Usually only $\frac{1}{5}$ or $\frac{1}{4}$ of the oxygen load is released, as the tissues are not able to absorb more than they need at the moment. The rest of the oxygen remains in the hemoglobin as an emergency reserve supply.

Interestingly enough, the average man has (30,000,000,000,000) red cells in his blood, or about $2\frac{1}{2}$ trillion per pint. Women have slightly fewer red cells, about $27\frac{1}{2}$ trillion. Under emotional stress or strenuous exercise, the number of red cells increases. Also, at high altitudes or high temperatures they are more numerous.

An important thing to remember about intravenous medication is this: The amount of salt in the blood stream is about nine-tenths of 1 percent or 0.9 percent. This is called isotonic saline and has the same osmotic pressure as tissue fluid. If the percentage of salt is less, the red cells will absorb water, swell, and burst. Some bacterial products cause this. These are called hemolysins, causing hemolysis or destruction of the red cell.

If, on the other hand, the salt solution is above normal concentration, it will draw water from the red cells and cause them to shrivel up and shrink and become crenated (krinkled).

Arterial blood is bright red because its hemoglobin is combined with oxygen, and the blood in the veins is dark red because the hemoglobin has given off its oxygen and exchanged it for carbon dioxide.

White Blood Cells

White blood cells or leukocytes are made in the bone marrow and in certain lymphoid tissues of the body. There is only one white cell to every 600 red cells. These white cells are important for protection of the body against disease.

They have the ability to move and crawl through little openings in the blood vessels, to engulf solid particles, and to attack bacteria. Since white cells can reach almost any part of the body, they travel from place to place as they are needed. By squeezing through crevices in the walls of capillaries, white cells are able to move out of the blood vessel and into the body tissue to reach the place of injury or infection. When your body is attacked by an invading disease, the white cells close in. One group, the neutrophils, fight the bacteria by eating them. As many as twenty bacteria have been found inside one attacking white cell. Other white cells clean up after the neutrophils, by eating dead cells, pigment, and other debris. If the attacking white cells are inadequate to ward off the infection, additional forces are called out. The cell-forming organs of the body get the "alarm" and release reserves into the blood. This elevates the normal white count of 6,000 to 8,000 white blood cells per cubic millimeter to greater numbers, often 15,000 to 20,000 and even higher. This increase in the number of white cells in the blood stream is usually an indication of infection and is known as leukocytosis. It is also seen in malignant growths and poisonings.

Certain virus diseases cause a drop in the number of white blood cells below the normal; this is called leukopenia. It is also found in some uncomplicated infections, and when the patient is so weak and exhausted that he cannot muster enough white blood cells to fight the infection.

White cells are divided into three distinct groups by their appearance under the microscope. Granulocytes are those having divided nuclei and granules when they are stained. Lymphocytes are dark-staining cells having a large nucleus, and are derived from lymphoid tissues. Monocytes are similar to lymphocytes, having a large nucleus and pale cytoplasm. There are three varieties of granulocytes, called neutrophils, eosinophils, and basophils. All of these are known as polymorphonuclear, or "polys" for short, by the laboratory technician.

Blood smears are stained and examined for various white blood cells, by a "differential count."

In acute infections the number of "polys" may increase, giving the doctor an index of the severity of the infection. Other white cells increase in leukemia (cancer of the blood), infectious mononucleosis, and other diseases about which your pathologist will tell you.

Platelets

Blood platelets, or thrombocytes, are round bodies in the blood that contain no nucleus but only cytoplasm. They are smaller than red blood cells and number from 300,000 to 800,000 per cubic millimeter of blood. They are essential for blood coagulation or clotting, since they mix with fibrin to form a firm clot.

THE BLOOD VESSEL SYSTEM

The blood vessel system is a closed circulation of the blood in vessels which begin at the heart and extend to the arteries, the capillaries, and the veins. This closed system of tubes, called blood vessels, circulates the vital oxygen-carrying blood to all parts of the body. The heart is the muscle pump which propels the blood through the vessels.

The heart is a hollow muscle located in the front and center of the chest between the lungs, with a large part of it lying directly behind the sternum. It is about the size of a closed fist and closely resembles a strawberry in shape. The base of the heart is upward toward the neck, and the apex, or point, is downward and to the left.

The heart is enclosed in a membranous fluid-filled sac, the pericardium. The fluid lubricates the outside of the heart as it beats. The inside of the heart is lined with a delicate serous membrane similar to that of the blood vessels.

The muscle of the heart is striated but involuntary, and the muscle fibers spiral and intertwine with one another, so that the heart contracts with a wringing motion to squeeze the blood into the blood-vessel system.

Inside, the heart is divided into chambers, two upper receiving chambers, the auricles, and two lower ejecting chambers, the ventricles. These four cavities are called the right and left auricles, and the right and left ventricles. The wall of the left ventricle is thicker, since it does more work than the right ventricle.

Between the auricles and the ventricles are valves which close when the heart contracts. This is to prevent a backflow of blood into the auricles.

The heart has its own system of blood vessels called right and left coronary arteries and veins. It is under the control of two sets of nerves which are in delicate balance, the vagus nerve which keeps the heart beating at a slow regular rate, and sympathetic nerves which speed it up under times of emergency. The central nervous system can regulate the speed of the heart beats, but it cannot cause the contractions of the heart. Their cause is still a mystery.

The heart action consists of wavelike contractions, beginning in the auricles and passing to the ventricles. The contractions are followed by dilations, and the two conditions alternate.

The normal heart rate is about 72 beats per minute.—This varies with age, weight, sex, the amount of exercise, and temperature of the individual.

Contraction of the heart is called systole and is the period of work; dilatation, or diastole, is the period of rest or relaxation.

A complete cardiac cycle is the time it takes from the appearance of one heartbeat to the next.

Arteries are elastic tubes that carry blood from the heart to the body. They have an inner lining of silky white tissue, a middle muscle layer, and an outer elastic tissue layer. Arteries have their own nerve supply from the autonomic nervous system, by which the size of the arteries can be varied by opening them up (dilatation) or making them smaller (constriction). The smaller arteries are called arterioles.

Capillaries are tiny vessels at the end of the arteries, which feed the blood back into the veins. They have very thin walls and communicate with each other and form a dense interlacing network in all parts of the body. As the blood passes through the capillaries, it takes up the various waste products that are to be carried away in the veins and gives oxygen to the tissues. This exchange takes place through the very thin walls of the capillaries.

Veins are hollow elastic tubes that carry blood back to the heart. Similar to the arteries, their walls are thinner, with less muscle tissue. Veins have valves which prevent the backflow of blood.

They begin as tiny venules formed from capillaries which have joined together much as tiny rivulets connect and form a small stream.

THE CIRCULATION OF THE BLOOD

If you think you are overworked, just think of this: Every day your heart beats 100,800 times and your blood circulates a total of 1,440 times, while your lungs inhale 438 cubic feet of air. And you're complaining? Think of your heroic heart and lungs.

Now let us trace the circulation of the blood from the heart through the body and back again to the heart. The logical place to start is as the impure venous blood enters the heart at the right auricle (receiving chamber) and passes into the right ventricle. As the right ventricle contracts, the tricuspid valve between these two chambers closes to prevent a blackflow of blood. Then as the blood is forced from the right ventricle, it opens the semilunar valves in the pulmonary artery. The pulmonary artery divides into two branches, one going to each lung, where it divides into smaller arteries, arterioles, and capillaries and finally reaches the tiny air sacs (alveoli) of the lungs.

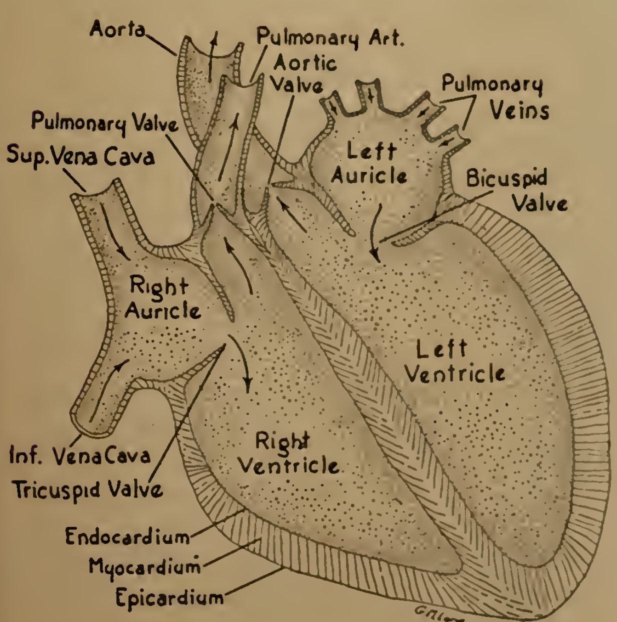

Figure 22.—Diagram of the Heart.

During its circulation through the lungs, the blood takes on oxygen and is returned through small vessels to the four pulmonary veins, two from each lung, which finally empty into the left auricle of the heart. This circulation from the right side of the heart to the left side of the heart is called the pulmonary circulation of the blood and is designed to purify it. As the blood passes through the lungs, it gives up carbon dioxide and takes on fresh oxygen. Thus freshened, the blood returns bright crimson to the heart. The marvel of the pulmonary circulation is that it takes only 10 seconds of time to accomplish this purifying process.

From the left auricle (receiving chamber) the blood passes to the left ventricle through the bicuspid or mitral valve. As the left ventricle contracts it snaps the mitral valve closed and opens the aortic semilunar valves into the aorta. Once in the aorta, the blood flows through its arterial branches to smaller arteries, to arterioles, to capillaries, and to every part of the body. It is then returned by the capillaries to the veins and finally reaches the right auricle through the superior vena cava and the inferior vena cava, the largest veins in the body.

The pulse that you feel in your wrist is formed by the contraction of the left ventricle which forces the blood into the arteries and causes a wavelike expansion of the arteries which is synchronous with the heartbeat.

It takes about 1 minute (60 seconds) for the blood leaving the heart to return after making a complete circuit of the body.

As you listen through the doctor's stethoscope to the beating of your own heart, you will hear a steady rhythmic lubb-dupp, lubb-dupp. This is the sound of blood coursing through the valves and chambers of the heart and the sound of the closing of the valves.

In 24 hours your heart receives and pumps out again some 10,000 quarts of blood, and expends enough energy to raise a 150-pound man to the height of the Empire State Building. In 70 years your heart will beat $2\frac{1}{2}$ billion times without a single shutdown for repairs. Though your heart weighs but $\frac{1}{200}$ of the body weight, it requires for itself $\frac{1}{20}$ of the blood in circulation.

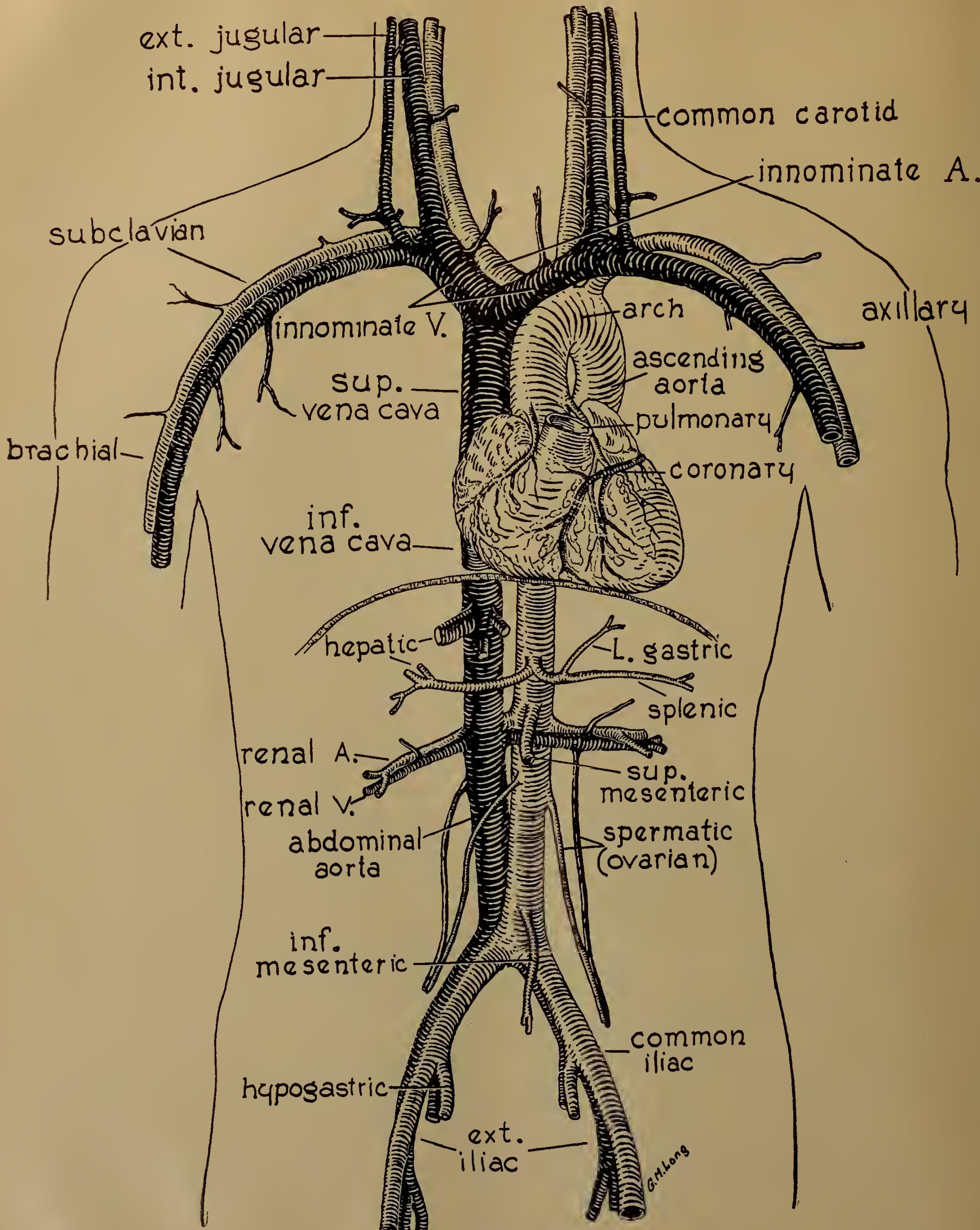

Figure 23.—Arteries and Veins of Torso.

BLOOD PRESSURE

Blood pressure is the force your heart exerts to push the blood through the arteries. The highest pressure is called systolic blood pressure since it is caused when the heart is in systole, or contraction. A certain amount of blood pressure is maintained in the arteries even when the heart is relaxed and this is the diastolic blood pressure since it is present during diastole, or relaxation, of the heart.

Normal blood pressure for young adults is: Systolic, 120 mm. of mercury; diastolic, 70 to 90 mm. of mercury.

Pulse pressure is the difference between the systolic and the diastolic pressure. For example, a person having a blood pressure of 120/80 would have a pulse pressure of 40.

THE BLOOD VESSELS

The system of arteries and arterioles is similar to that of a tree, with the aorta as a trunk, the arteries as large branches, and arterioles as small twigs. The blood circulates from the aorta to the arteries and then the small arterioles. In some cases the small arterioles unite in what is known as an anastomosis, as they do in the palm of the hand.

The aorta is the large tubelike structure which arises from the left ventricle of the heart and arches upward around the left lung and then down along the spinal column through the diaphragm. Along the way it gives off arteries to the head, neck, arms, chest, and abdomen, before finally dividing to send arteries down both lower extremities.

The aorta also sends small branches, called coronary arteries, to the right and left sides of the heart, to nourish the heart muscle.

There are certain branches of the aorta with which you should be familiar since these often must be compressed to prevent hemorrhage, and you will later learn in first aid the pressure points which must be held if severe hemorrhage is to be avoided. Three large arteries arise from the aorta as it arches over the left lung. The first of

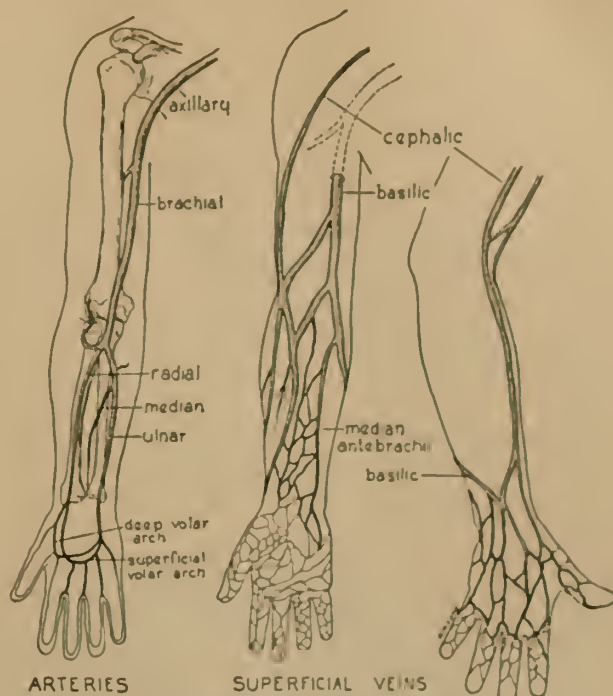

Figure 24.—Arteries and Veins of the Upper Extremity.

these branches is the innominate artery, which divides into the right subclavian artery, to supply the right arm with blood, and the right common carotid, to supply the right side of the head.

The next large branch is the left common carotid, which supplies the left side of the head. The third large branch from the arch of the aorta is the left subclavian, which supplies the left arm with blood. On your diagrams you should learn the location of the pressure points where these arteries can be compressed.

The carotid arteries divide into internal and external branches—the external supplying the muscles and skin of the face, the internal supplying the brain and the eyes.

The subclavian arteries are so named because they run underneath the clavicle (sub meaning under, and clavian, clavicle). They supply the upper extremity and give off branches to the back, the chest, the neck, and even the brain via the spinal column.

The large artery going to the arm is called the axillary. This eventually divides into the ulnar and radial arteries. The radial artery is the one

at the wrist which you will feel to take the pulse of your patients.

The aorta as it passes into the chest is called the thoracic aorta and gives off branches to supply the lungs, the chest wall, and the heart.

The abdominal aorta gives off branches to the abdominal viscera, including the stomach, liver, spleen, kidneys, and intestines. It finally divides into the right and left common iliacs which send large arteries to the lower extremities. On entering the thigh, the artery is called the femoral artery, and here again, on the inside of the thigh, is a pressure point that you should learn, for this artery is frequently injured in fractures and must be compressed with a tourniquet to prevent hemorrhage.

Lower down in the leg the artery becomes the popliteal. Here it is located just behind the knee and can be compressed against the bone of the tibia or lower end of the femur.

Since arterial blood arises at the heart, we trace arteries from the heart, but to return blood to the heart we trace veins from their smaller extremities called venules, back through the larger veins. There are three main sets of veins in the body, called the pulmonary—those from the lungs; the systemic—those from the rest of the body other than the digestive system; and the portal system—those returning blood from the intestines, spleen, and liver.

The pulmonary veins are four, returning blood from the lungs to the left auricle of the heart. These are the only veins in the body that carry freshly oxygenated blood.

The systemic veins are divided into deep and superficial. The deep veins are usually located in the muscle or internal organs; the superficial veins lie just under the skin.

The large superficial veins of the head are called the external jugular veins. They drain blood from the scalp, face, and neck and finally empty into the subclavian veins.

The veins which drain the brain itself and internal facial structures are called the internal jugular veins. These, too, combine and finally empty into the innominate vein and superior vena cava.

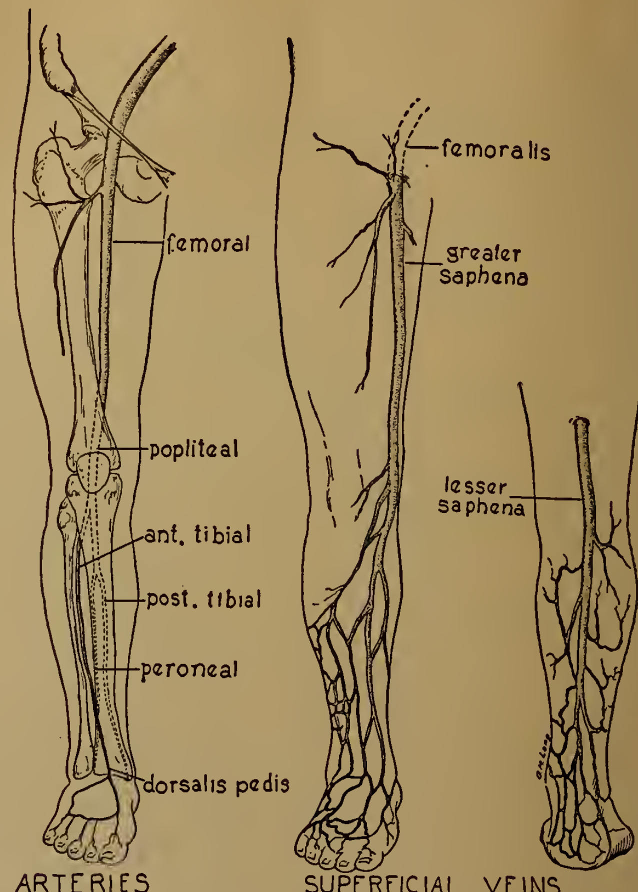

Figure 25.—Arteries and Veins of the Lower Extremity.

The superficial veins of the upper extremity begin at the hand and extend upward. There is one set of veins with which you should be familiar, called the median cubital or median basilic veins, as they cross the elbow. These are the veins most commonly used for intravenous injections.

In the lower extremity there is a superficial vein called the long saphenous, which starts on the inner side of the foot and runs up the inside of the leg and thigh to join the femoral vein in the groin. This vein is sometimes used at the ankle for intravenous injections. In persons who do prolonged standing, such as barbers, surgeons, and housewives, this venous system often becomes varicose and needs to be tied off at the groin or other places to prevent varicose ulcers from forming.

The femoral vein is the large deep vein of the thigh.

The portal system of veins is that which drains the blood from the stomach, intestines, spleen, pancreas, gallbladder, and liver. It finally empties into the inferior vena cava.

THE LYMPH AND THE LYMPH-VASCULAR SYSTEM

Lymph

Lymph is a clear fluid, rich in white blood cells, and is actually blood plasma which has filtered through the walls of capillaries.

It is circulated through the lymph vessels and in all the tissue spaces of the body. It carries nourishment and oxygen to the tissues and waste products from them. The tissues and organs of the body are bathed in lymph, so it also acts as a lubricant in aiding movement. After a meal, lymph coming from the small intestine has a milky appearance because of the presence of fat. This milky lymph is called chyle.

Lymph-Vascular System

Lymph vessels and lymph glands form a network throughout the body. Similar to the veins, they collect lymph and begin its flow from the tissues toward the heart, eventually emptying into the thoracic duct and the right lymphatic duct. These ducts end by emptying into the left and right subclavian veins respectively.

Lymph Vessels

Lymph vessels are located in every part of the body that has blood vessels, except the brain, spinal cord, eyeball, and internal ear. Like veins, many of the lymph vessels contain valves which prevent backflow of lymph, but unlike veins, they communicate directly or indirectly with the great serous cavities of the body such as the pleural and peritoneal. Along the course of lymph vessels are spaced lymph glands of various sizes.

The lymphatic capillaries drain lymph from the tissues of the deep structures and also from the skin and superficial tissues. They unite to form larger vessels. With increased size, the walls become stronger, until finally they are composed of three layers, like blood vessels.

Lymph Glands

Lymph glands are small bean-shaped bodies found in groups of two to fifteen along the course of lymph vessels. Sometimes just beneath the skin they appear alone. Glands, made of lymphoid tissue, vary in size and act as filters to remove bacteria and particles from the lymph stream. Lymph glands also manufacture the white blood cells called lymphocytes.

THE RESPIRATORY SYSTEM

Respiration

Respiration, or breathing, is taking air into the lungs to obtain oxygen in exchange for carbon dioxide, which is exhaled.

Respiratory Organs

In man the respiratory organs are the nose, the mouth, the pharynx, the larynx, the trachea, the bronchi, and the lungs. Accessory organs that make breathing possible are the thorax, the ribs, and the diaphragm. See figure 26.

Air enters the nose and nasal chambers, where it is filtered by little hairs called cilia. These take out dust particles that would irritate the lungs. The chambers of the nose also warm and moisten the inspired air.

The air then passes through the back part of the mouth, where it is moistened even more.

The pharynx is the passageway between the nasal chambers, the mouth, and the larynx.

The larynx, or voice box, is just below the pharynx, and helps to form your "Adam's apple." It is pulled upward against the base of the tongue and closed, when you swallow, to keep food from entering the lungs. All air must pass through the larynx to the lungs, and air passing from the lungs to the larynx makes sound, which we call speech or singing.

The trachea, or windpipe, is a tube formed of ribbed cartilage with 15 or 20 C-shaped rings. It is lined with cilia and mucous glands to filter out dust and dirt.

Bronchi are branches from the trachea which carry the air to the smaller elements of the lung, the bronchioles and the alveoli, or air sacs.

The lungs are like two large sacs which are divided into lobes, each sac containing thousands

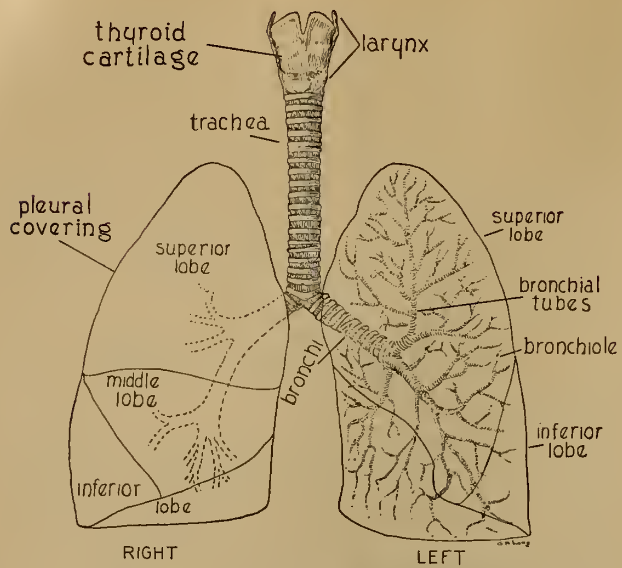

Figure 26.—The Lungs and Air Passage.

of tiny alveoli with blood capillaries in their lining membrane. The air entering the lungs here comes directly in contact with the permeable membrane of the air sac, so oxygen filters through the membrane into the blood stream.

Each lung is encased in a serous sac called the pleura, which is smooth and has a small amount of fluid in it to prevent friction from the rubbing of the lungs against the chest wall.

Figure 27.—Minute Structure of the Lung.

The mediastinum divides the chest into two separate cavities. The heart lies in this space.

Process of Respiration

Respiration includes not only the exchange of oxygen and carbon dioxide in the lungs, but also the reverse exchange which takes place between the capillaries and the tissues of the body.

The rhythmical movements of breathing are controlled by the respiratory center in the brain. Nerves from the brain pass down through the neck to the chest wall and the diaphragm. The nerve to the diaphragm is called the phrenic, the nerve to the larynx is the vagus, and those to the muscles of the thorax, the intercostals.

The respiratory center is stimulated by chemical changes in the blood, especially if they are acid. If too much carbon dioxide accumulates in the blood, the respiratory center tells the lungs to breathe faster to get rid of the carbon dioxide.

Other stimulations of the body can cause increased breathing; for example, the splashing of cold water on the face or the chest will stimulate breathing; a sudden splash into cold water will cause a deep gasping inspiration. Emotional disturbances of the brain also can alter respiration, causing shallow breathing, sighing, laughing, or crying.

The muscles of respiration normally act automatically. The respiratory cycle consists of inspiration—breathing air into the lungs; expiration—breathing air out of the lungs; and rest—an interval between breaths.

Normal respiration is 14 to 18 cycles per minute.

In the act of inspiration, the diaphragm contracts, the ribs are elevated, and negative pressure is produced in the chest. This draws air into the lungs to equalize the pressure. In expiration, the diaphragm relaxes and the elasticity of the lungs, together with the weight and the elasticity of the chest walls, causes the chest to return to its original size, thus expelling the air from the lungs.

The lungs when filled to their full capacity hold about 4,500 cc. of air, but only 500 cc. of air is breathed out at a normal quiet expiration. This air that is changed with each respiration is called tidal air. The amount of air breathed out or in may be increased by forceful expiration and inspiration. The amount of air left in the lungs

after forceful expiration is about 1,000 cc., and is known as residual air. Under normal conditions the reserve supply of air in the lungs is about 2,600 cc.

Certain sounds are produced by passage of air into and out of the lungs. These sounds may vary in disease of the lung. Doctors depend upon these sounds of the lungs during respiration to diagnose pneumonia, bronchiectasis, tuberculosis, and other lung diseases.

Types of Breathing

Eupnea	Ordinary quiet respiration where no effort is expended.
Dyspnea	Labored or difficult breathing.
Hyperpnea	Applies to the initial stage of dyspnea when the respiration rate is simply being increased.
Apnea	A condition in which there is a temporary cessation of breathing.
Cheyne-Stokes	The respirations increase with force and frequency up to a certain point, and then decrease until they cease altogether. There is a short period of apnea; then the respirations begin again, and the cycle is repeated.
Edematous respiration.	A moist, rattling sound, sometimes referred to as the "death rattle." It is caused by the infiltration of fluid from the blood into air cells of the lungs.
Asphyxia	The condition produced by oxygen starvation. It is caused by prolonged interference with aeration of blood.

DIGESTIVE SYSTEM

The digestive system is the alimentary tract, which begins at the lips and ends at the anus, and the accessory organs of digestion (salivary glands, liver, pancreas, gallbladder). The digestive system carries food so that digestion and absorption can occur, and it eliminates waste material. The secretions of the accessory organs assist in preparing the food for its absorption and use by the tissues of the body.

Digestion is both mechanical and chemical. The food is mechanically chewed, swallowed, churned by peristalsis, and evacuated when the bowels move. The chemical digestion consists of breaking down the various foods, by enzymes, into solutions and simple compounds. Carbohydrates

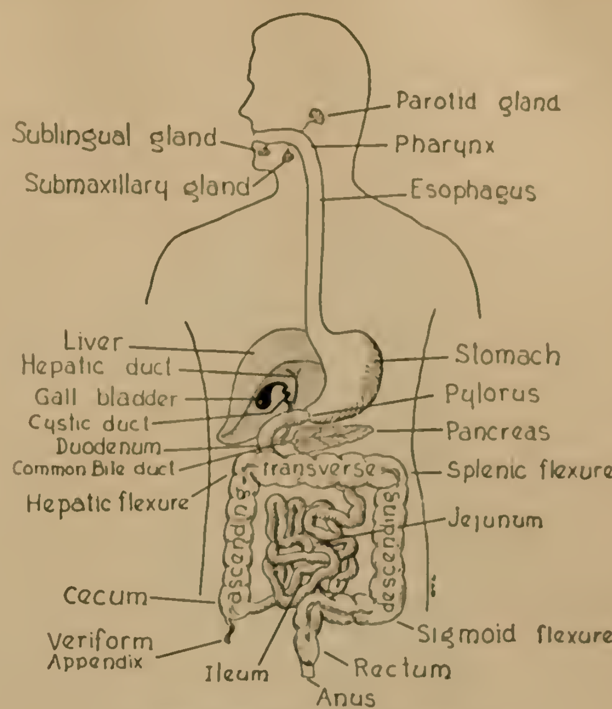

Figure 28.—The Digestive System.

(starches and sugars) must be broken down into simple sugar (glucose); fats are changed into fatty acids; proteins into amino acids (table 1).

Structure of the Digestive System

The alimentary canal is about 28 feet long and is divided as follows:

Mouth cavity:	Large intestine:
Teeth	Cecum
Tongue	Ascending colon
Pharynx	Transverse colon
Esophagus	Descending colon
Stomach	Sigmoid colon
Small intestine:	Rectum
Duodenum	Anus
Jejunum	
Ileum	

The accessory organs that aid the process of digestion are:

Salivary glands	Gallbladder
Pancreas	Intestinal glands
Liver	

The Mouth

In the mouth the teeth break up the food into small particles before it is swallowed. Here the salivary glands secrete saliva to help the digestion

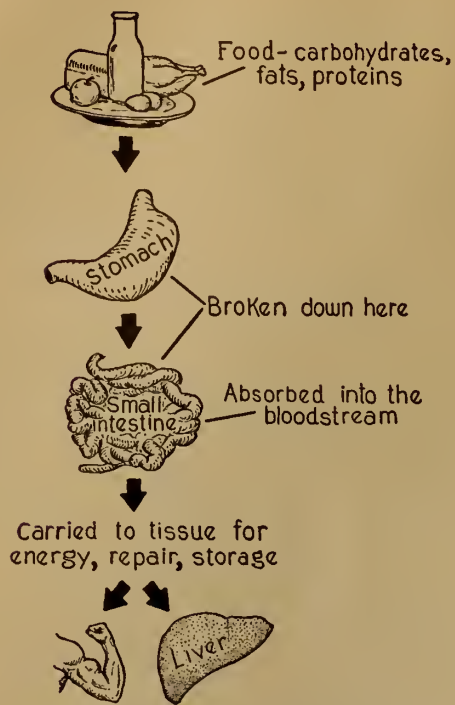

Figure 29.—Schema of the Digestive Process.

of starches and sugars. About 1,500 cc. (1½ quarts) of saliva is secreted daily. This moistens the food, makes it easier to chew, and lubricates the food mass to aid in swallowing. The two enzymes which help digest starches and sugars are ptyalin and maltase; they act upon starches and break them down into sugars called maltose and dextrose.

The tongue is a muscular organ attached at the back of the mouth to the lower jaw. It is concerned in taste, speech, mastication, and swallowing.

Pharynx

The pharynx is the connection between the nose and mouth and the esophagus. It is a musculomembranous tube, placed behind the nasal cavities, mouth, and larynx. Corresponding portions of the pharynx are respectively named nasopharynx, oropharynx, and laryngeal pharynx. The pharynx serves as a passageway both for air and for liquids and food.

Esophagus

This is a muscular tube 10 inches long extending from the pharynx to the stomach. It passes through the chest and by means of waves of muscular contraction called peristalsis it pushes the food along to the stomach. When peristalsis is reversed, vomiting occurs. This may be the result of overloading the stomach, disease in the intestinal tract, abnormalities of the brain, or a toxic reaction to certain drugs.

Stomach

The stomach is a large muscular bag which is located in the upper abdomen in connection with the esophagus at its upper end and the first portion of the small intestine, the duodenum, at its lower end. There are small muscular rings at each end of the stomach; the one at the upper end is called the cardiac sphincter, and that at the lower end is called the pyloric sphincter. These tend to close off the stomach and prevent food from escaping in either direction while digestion is taking place.

The stomach is a storehouse for food and releases food in liquid form in small amounts when the rest of the digestive system can take care of it.

The stomach helps in the chemical breakdown of food materials. Small glands in the wall of the stomach secrete gastric juice. This contains two enzymes, pepsin and rennin, which act on protein, and a third enzyme, gastric lipase, which splits fats. Gastric juice also contains hydrochloric acid which helps the action of pepsin, tends to kill any bacteria that enter the stomach, and regulates the opening and closing of the pyloric sphincter. When food leaves the stomach it is in semiliquid form called chyme. At this point it is about half digested; the complex starches are partly split into simple sugars, and the proteins are broken down into simpler forms, peptones.

Small Intestine

The small intestine is a muscular tube about 22 feet long and is attached to the spinal column and abdominal cavity by means of a thin band of tissue called the mesentery. In this band of tissue are located the blood vessels. The mesentery is gathered together like a fan, and this gathering arrangement permits folding and coiling of the intestines so that this long organ can be packed into a small space. The small intestine is divided into three long continuous parts: duodenum, jejunum, and ileum. It receives digestive juices

from three accessory organs of digestion: the pancreas, liver, and gallbladder.

Duodenum.—The duodenum is a tube about 10 inches long and forms a C-shaped curve just below the liver, around the head of the pancreas. The duodenum itself is lined with small glands which secrete intestinal juice containing the enzyme, invertase, to convert sugars into their simplest form. They also secrete erepsin, which acts on the peptones (split proteins) to change them into amino acids. The pancreas, liver, and gallbladder have ducts which open into the duodenum.

Jejunum.—This is the middle part of the small intestine, about 7½ feet long, and its enzymes continue the digestive process.

Ileum.—This is the last and longest part of the small intestine; it ends at the large intestine, or colon. Most of the absorption of the food takes place in the ileum, where fingerlike projections from the muscle wall, called villi, provide a large surface for absorption. The villi contain central lymph channels and a network of blood capillaries. After the food has been digested it is absorbed into the capillaries and lymph channels and thence carried to all parts of the body by the blood and lymph.

Pancreas.—The pancreas is a long, pistol-shaped gland lying behind the stomach. It empties into the duodenum and has digestive juices that act on all types of food. It contains a special group of cells, the Islands of Langerhans, which secrete the hormone, insulin, needed for the use of sugar by the body tissues. Lack of insulin causes diabetes. Insulin enters the blood directly and does not go by way of the intestinal tract, as do the other pancreatic enzymes.

Table I.—DIGESTIVE JUICES AND THEIR ACTION

Digestive juice	Source	Acts upon—	To produce—
Ptyalin	Salivary gland	Starch	Complex sugar (maltose).
Maltase	do	Complex sugar (maltose).	Simple sugar (glucose).
Pepsin	Lining of the stomach.	Protein	Split proteins (proteose and peptone).
Rennin	do	Milk	Coagulate milk.
Gastric lipase.	do	Fat	Small, fat particles.
Hydrochloric acid.	do	Keep stomach content acid	To facilitate the action of other juices.
Amylase	Pancreas	Starch	Complex sugar (maltose).
Trypsin	do	Split proteins (proteose and peptone).	Peptids and polypeptids.
Erepsin	do	Peptids	Separate amino acids
Lipase	do	Fat	Fatty acids and glycerin.
Bile	Liver	do	A solution of fat in watery fluid of intestine.
Invertase	Lining of the duodenum.	Complex sugar (sucrose and lactose)	Simple sugars (fructose, galactose, and glucose).
Erepsin	do	Peptids	Separate amino acids.

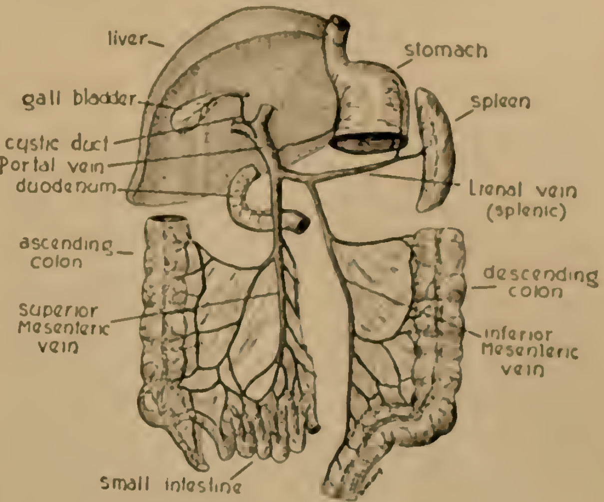

Figure 30.—The Portal System.

Liver.—The liver is the largest gland in the body. It is located in the upper abdomen on the right side, just under the diaphragm and above the duodenum and the lower end of the stomach.

One function of the liver is to secrete bile needed to digest fats in the intestines. Bile does not contain a fat-splitting enzyme but does break up the fat particles so that lipase and steapsin can act more rapidly. Besides secreting bile, the liver has other functions:

1. It is a storehouse for sugar (glycogen).
2. It plays a part in destroying bacteria and wornout red blood cells. It takes the iron from old cells and stores it for use in making new blood.
3. It detoxifies chemicals and poisons.
4. It manufactures part of the proteins of blood plasma.
5. It assists in making antibodies for defense against disease.
6. It has an important role in fat metabolism, and plays a part in metabolism of vitamin A and and storage of vitamin B.

These are only some of the known functions of the liver and there are probably still others yet to be discovered.

Gallbladder.—The gallbladder is a dark green

sac, shaped like a blackjack and located in a hollow on the under side of the liver. Its duct, the cystic duct, joins the hepatic duct to form the common bile duct which enters the duodenum. The main function of the gallbladder is the storage and concentration of bile when not needed for digestion.

Large Intestine

The large intestine is about 5 feet long and is divided into the cecum, the ascending colon, the transverse colon, the descending colon, the sigmoid colon, and the rectum, which opens through the anus. In the large intestine, unabsorbed food material is stored. Here water is reabsorbed while the food is being pushed along, finally to be eliminated from the body in the bowel movements.

The unabsorbed food that enters the cecum, a blind sac located at the lower right side of the abdomen, eventually travels through the ascending, transverse, descending, and sigmoid colon to reach the rectum. As the unabsorbed food mass moves through the colon, liquid is absorbed. Most of the water absorption by the body takes place in the colon.

The appendix is a long, narrow tube with one blind end, the other end being attached to the cecum near the ileocecal junction. It has no known function, but frequently becomes infected and inflamed. This is known as appendicitis.

The Rectum and Anus

The rectum is about 5 inches long and follows the curve of the sacrum and coccyx until it bends back into the short anal canal. The anus is the external opening at the lower end of the digestive system. It is kept closed, except during bowel movements, by a strong sphincter muscle. The function of the rectum and anus is wholly elimination.

Time Required for Digestion

Shortly after a meal reaches the stomach, it begins to pass through the pylorus, and after the first hour the stomach is half empty. At the end of the sixth hour none of the meal is present in the stomach. The meal then goes through the small intestine and the first part of it reaches the cecum in from 20 minutes to 2 hours. At the end of the sixth hour most of it should have passed into the colon: in 12 hours all should be in the colon. Twenty-four hours from the time the food is eaten, the meal should reach the rectum; however, part of the residue may be defecated at one time and the rest at another.

Food Absorption

There is very little absorption in the stomach. Alcohol is absorbed directly through the stomach wall, accounting for the fact that it doesn't take long to become intoxicated if you drink on an empty stomach. Most food absorption takes place in the small intestine. The liquid products of digestion pass through the mucous lining of the intestines to either the lymphatics or the tributaries of the portal circulation which leads to the liver. The colon absorbs only water and the concentrated residue is eliminated as feces.

Defecation

The passage of feces, or a bowel movement, is called defecation. It is begun by contraction of abdominal and pelvic muscles. At the same time, the sphincters of the rectum relax and there is a peristaltic wave of the sigmoid colon and rectum. The feces are then expelled as the result of these coordinated muscle actions.

Fecal material is made up of undigested food residue, secretions from the digestive glands, bile, mucus, and millions of bacteria. Mucus is derived from the many glands of the colon, which pour out their secretion to lubricate the mass as it moves through the colon and rectum. Bacteria are especially numerous in the large intestine. They act on food, causing putrefaction of proteins and fermentation of carbohydrates. This tends to break up the food mass into a softer stool.

Abdominal Cavity

The stomach and intestines are enclosed in the space between the diaphragm and the pelvis, called the abdominal cavity. This cavity is lined with a serous membrane, the peritoneum. The peritoneum covers the intestines and organs and by secreting a serous fluid prevents friction between the adjacent organs. Layers of peritoneum that extend from the body wall to an organ and sus-

pend it are called the mesentery. The mesentery carries blood vessels to the different organs. Folds of peritoneum lie in the front part of the abdomen connecting the stomach, liver, and parts of the intestines. These are called the omentum. The upper part is called the lesser omentum; the lower part, which hangs below the stomach and over the intestine like an apron, is called the greater omentum. This contains fat throughout.

ENDOCRINE SYSTEM

The endocrine system is made up of the glands of internal secretion, called ductless glands because they have no ducts to carry away their secretions. The secretion of an endocrine gland is called a hormone (meaning, I excite). The hormones are very small in quantity, only a trace being necessary to produce an effect. They reach the effector organ through the blood stream. Some of them influence the activity of the body as a whole. Most hormones can be obtained by extraction from the gland of an animal. Some can be prepared synthetically. These isolated hormones may be administered to patients who are ill or have a deficiency of them. The hormone-producing glands are: the thyroid, parathyroids, adrenals, pituitary, gonads (sex glands), pancreas, intestinal glands, pineal body, and thymus (fig. 31).

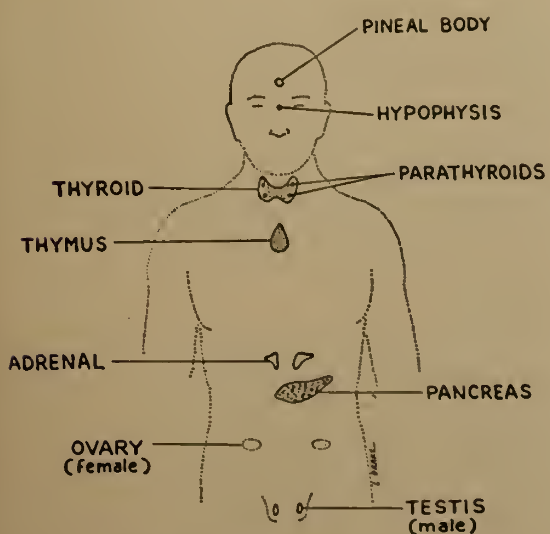

Figure 31.—The Endocrine Glands.

Spleen

The spleen, although not physiologically a gland of internal secretion, has no ducts and is therefore anatomically a ductless gland. Located in the upper left part of the abdomen beneath the diaphragm, it is enclosed in a capsule of connective and muscular tissue. It is roughly circular in outline and in the average adult weighs about 7 ounces. Its chief functions are:

1. Formation of lymphocytes and monocytes.
2. Phagocytosis of bacteria, inert particles, white blood cells, and probably platelets.
3. Destruction of old red blood cells; storage of iron and blood.

Under stress of excitement, during exercise, or after injection of adrenalin, the spleen contracts, forcing blood into the circulation. In this sense the spleen is a reservoir of blood cells for emergency use.

The spleen is thought to produce a coagulating substance, as well as an inhibitar of platelet formation and certain immune substances.

Even though the spleen has many functions, its removal causes no permanent damage. There is no evidence that the removal of the spleen renders man less resistant to infection.

The spleen is fairly easily ruptured, due to its soft, spongy consistency. Hemorrhage results. A hemorrhage may be slow and delayed. Bleeding has been known to occur as long as 2 years after an injury.

Thyroid Gland

The thyroid gland sits like a butterfly in the front part of the neck below the larynx. It consists of two lobes, one on each side, connected in the middle by a strip of tissue called the isthmus. The hormone secreted by the thyroid is thyroxin and stimulates the rate of metabolism of the body. Excessive secretion of thyroxin raises the metabolic rate and causes a condition known as hyperthyroidism. Patients with hyperthyroidism have a fast pulse rate, dizziness, increase in the basal metabolism, profuse sweating, and a tremendous appetite yet a loss of weight. The eyeballs may protrude, and enlargement of the thyroid may at first be felt and later observed in the lower neck.

Hypothyroidism is caused by an insufficient secretion of thyroxin. It is the opposite of hyperthyroidism. The patient has a decrease in basal metabolism, sweating is almost absent, and he may gain weight easily and feel continually tired. The heart may be slow. There may be an enlargement of the gland, called a goiter.

To prevent goiter one should eat food which contains iodine: vegetables, iodized salt, and sea food.

Parathyroid Glands

Parathyroid glands are small round bodies, usually four, located just behind the thyroid gland. Their hormone regulates the calcium and phosphorus content of the blood. The amount of calcium is important in certain tissue activities, such as blood formation, coagulation of blood, maintenance of normal muscular excitability, and milk production of pregnant mothers. Removal of the parathyroid glands results in a low calcium level in the blood, and death preceded by tight contractions of the muscles and convulsions.

Adrenal Glands

The adrenal glands are sometimes referred to as the suprarenal glands, since they sit like small cocked hats on the top of each kidney. They consist of an inner portion called the medulla, which secrets epinephrine (adrenalin), and an outer portion called the cortex, which secretes a number of hormones that have differing functions.

Adrenalin, one of the body's most important hormones, is secreted into the blood stream and by stimulating the autonomic nervous system causes an increase in the heartbeat, blood pressure, blood sugar, and rate of blood clotting. In states of emotional excitement and increased activity, it makes possible the mobilization of the reserves of the body.

Pituitary Gland

The pituitary is a small pea-sized gland located at the base of the brain and has been referred to as the orchestra leader of the endocrines because of the fact that it has control over all the other endocrine glands in the body. It is divided into two lobes, an anterior and a posterior. The anterior lobe plays the master role and many different functions are attributed to it:

1. Its growth hormone influences skeletal growth. Disease of the gland may cause gigantism, dwarfism, or acromegaly (a disease in which the hands, feet, and lower jaw enlarge).
2. The thyrotropic hormone influences the thyroid gland, stimulating the thyroid to secrete its hormone.
3. The gonadotropic hormone influences the gonads (ovaries or testicles) and is essential for normal development and functioning of the reproductive system.
4. The adrenotropic hormone is related to the growth of the adrenal glands, and the absence of the pituitary leads to the rapid atrophy of the adrenal glands. A newly isolated hormone, ACTH, is in this category, since it stimulates the adrenal cortex. ACTH stands for adrenocorticotropic hormone.
5. The lactogenic hormone is responsible for the development of the breast during pregnancy, and for the production of milk.
6. The parathyroids and pancreas are also affected by the pituitary.

Pituitrin is a secretion of the posterior lobe of the pituitary. It affects smooth muscle, causing it to contract, and has an effect on the kidney to prevent excessive formation of urine.

Pitocin is another isolated hormone of the posterior pituitary which is given to cause contraction of the uterus after a baby has been delivered.

Gonads

The gonads, the ovaries in the female and the testes in the male, produce hormones that are important for the functioning of the reproductive system. These glands become active at puberty and are responsible for the appearance of secondary sex characteristics. These include pubic and axillary hair, the beard in the male, the development of the breasts in the female, and the changing of the voice.

Pancreas

The pancreas contains clusters of specialized cells called the Islands of Langerhans. These cells secrete insulin into the blood stream. Insulin is essential for the use and storage of carbohydrates by the body. When the islet cells are destroyed or stop functioning, the sugar absorbed from the intestine remains in the blood and is thrown off by the kidneys into the urine. It is not used and it

is not stored. This condition is called diabetes mellitus, or sugar diabetes. Insulin is given hypodermically to patients having this disease, as part of their treatment.

Intestinal Glands

The intestinal glands have hormones. The duodenum supplies a hormone, secretin, which causes the intestinal juices to flow whenever food reaches the intestines. The liver and spleen are also believed to supply hormones to the blood, but these have not as yet been isolated.

Pineal Gland

This is a small gland located near the roof of the brain. It is thought to exert an influence on the rate of growth of the entire body and the onset of puberty (when the reproductive glands of the body become active).

Thymus

The thymus is an organ located in front of the trachea, partly in the neck and partly in the thorax. It is large in infancy and shrinks as the individual matures. Little is known concerning the function of this gland.

THE EXCRETORY SYSTEM

Table II.—EXCRETORY ORGANS OF THE BODY

Excretory organs	Waste excretions
Kidneys	Nitrogenous wastes, toxins, water from ingestion, mineral salts.
Skin (sweat glands)	Water, mineral salts, small amounts of nitrogenous wastes.
Lungs	Carbon dioxide, water vapors, small amount of nitrogen.
Intestines	Wastes from digestion, some metabolic wastes, (bile pigment, salts of calcium, etc.).

Table III.—PHYSICAL CHARACTERISTICS OF NORMAL URINE

Characteristics	Description
Amount (24 hours)	40 to 50 fluid ounces (1,200 to 1,500 cc.). May vary more or less, depending on many factors, such as fluid intake, medicinal substances, atmospheric conditions and disease.
Clearness	Transparent or clear, upon standing becomes cloudy.
Color	Varies from pale yellow to a brownish hue. Color variations dependent on amount voided, foods and medicinal substances.
Odor	Odor of ammonia which is influenced greatly by disease, vegetable foods, and other substances.
Specific gravity	Varies from 1.015 to 1.025.
pH factor	Acid in reaction.

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Table IV.—CHEMICAL CHARACTERISTICS OF NORMAL URINE

Characteristics	Description
Composition	95 percent water, 5 percent solids composed of nitrogenous waste products, organic and inorganic salts.
Normal constituents	Chief nitrogenous constituent is urea present to the extent of about 2 percent. Organic salts of lactates, acetates, and small amounts of formates. Inorganic salts, sodium, calcium, ammonium, potassium, and magnesium.
Abnormal constituents	Albumin, sugar, acetone, casts, and blood may be found due to pathological conditions.

The waste products resulting from the activities of the body are called excretions and are discharged to the exterior by organs known as excretory organs, some of which are arranged in systems.

The Urinary System

The kidneys are two large, bean-shaped organs designed to filter waste materials from the blood. They are located in the upper part of the abdominal cavity, just outside the peritoneal sac, one on each side of the spinal column. The upper end of each kidney reaches above the level of the twelfth rib. The suprarenal gland (adrenal gland) sits like a cap on top of each kidney. The kidneys weigh about 4 to 6 ounces, and measure about 4½ by 2 by 1½ inches. Attached to the hollow

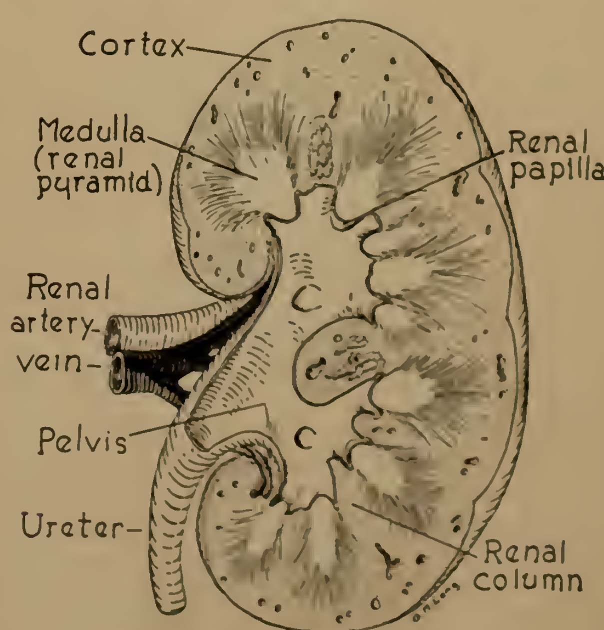

Figure 32.—Cross Section of the Kidney.

side of each kidney is the dilated upper end of a ureter, which is the outlet tube of the kidney and extends downward to the bladder, located in the pelvic cavity. The hollow side of each kidney, together with the dilated end of the ureter, forms the kidney pelvis.

The essential unit in the kidney is a tiny filtering sac called the glomerulus, in the hollow center of which is a coiled loop of blood capillaries. This glomerular sac has a narrow tubular outlet. The first section of this tubule is surrounded by capillary blood vessels to reabsorb certain essential elements in the urine. The coiled tubule is continued as a straight tubule, which finally unites with other similar tubules and empties into the kidney pelvis.

In action, the kidney is a blood filter, the watery portions of the blood passing through the capillaries and glomerular walls. The fluid filtered out of the blood flows out of the glomerular sac and down the tubule. On its way special cells lining the tubules select from the fluid essential substances which are still of use to the body, and return them to the blood stream. The combined water and wastes removed from the blood by the kidneys form the urine. These wastes would poison the body and kill it in a few days, if they were left in the blood stream. Urine is carried from the kidneys through the ureters to the bladder, from which it is expelled through the urethra. These structures do not perform any excretory work. They simply conduct the urine on its way out of the body, and the bladder acts as a temporary storage place so that urine can be expelled at convenient times instead of escaping in the form of a continuous dribble.

In the filtration of the urine each kidney has about one million glomeruli to perform its job. There are many reserve glomeruli, so that large portions of the kidneys may be destroyed by disease before the patient is seriously handicapped.

Blood pressure is also important in the speed at which the blood filters through the kidneys. If the blood pressure drops too low, as in shock, kidney filtration stops. If it goes too high, it may injure delicate cells in the kidney and cause damage to the kidney substance. Kidney damage is one of the complications of high blood pressure. Injury to the cells lining the tubules leads to a loss of substances which the body ought to retain, but does not necessarily cause high blood pressure. In this case the body may lose albumin which should be kept in the blood stream.

The blood that passes through the kidneys comes via the renal arteries from the aorta. They divide repeatedly into smaller and smaller branches until they are finally tiny, thin-walled capillaries found in the glomeruli. The venous return is by the renal veins.

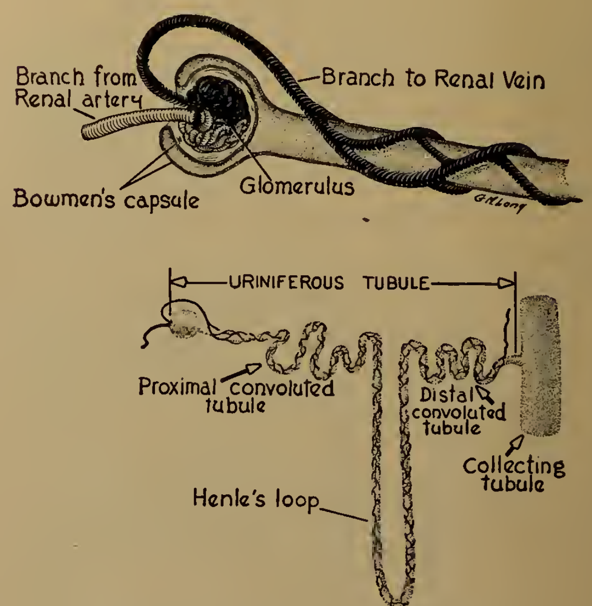

Figure 33.—Functional Unit of the Kidney.

How the Kidneys Work

The kidneys are effective blood purifiers. They filter waste materials from the blood and excrete them in a watery solution known as urine. They also play an important role in keeping the reaction of the blood normal, making sure that it does not get too acid or too alkaline. The normal blood reaction is slightly alkaline. They do this by excreting enough substances from the blood to maintain this alkalinity. For example, if the blood becomes too acid they will excrete acid in the form of salts; on the other hand, if too alkaline they will excrete alkaline salts.

The kidneys also remove excess sugar, when present in the blood, but the main job of the kid-

neys is to excrete nitrogenous waste products which are produced in the breakdown of proteins.

Besides filtration, the second important function of the kidneys is reabsorption of water, salts, sugar, and protein elements of the blood. This selective reabsorption keeps the blood at an acid-base balance and also a constant concentration of water, salts, and proteins. This delicate balance is essential for normal life. Controlled reabsorption accounts for the amount of urine which is finally passed from the kidneys, for the glomerulus filters gallons of blood each day. It is estimated that 10,000 quarts of blood pass through the kidneys in 24 hours and about 80 gallons of urine is formed, but all of the water from this urine is reabsorbed in the kidney tubules except that containing the concentrated waste products. The amount of urine excreted by a normal adult is from 1,000 to 1,500 cc. per day. However, a person can get by if he secretes even as little as 500 cc. per day.

The amount of urine varies greatly with temperature, water intake, and states of health or disease, but no matter how much water you drink the blood will always remain at a constant concentration, and the excess water will be excreted by the kidneys. A large water intake does not put a strain on the kidneys as some may think. Rather, it eases the load of concentration placed on the kidney.

In blood plasma there is normally present about 0.03 percent of urea, while in the urine there is normally 67 times as much, or about 2 percent. This great increase is largely due to concentrating the urea contained in a very large amount of kidney filtrate in a relatively small amount of urine.

Besides removing waste products normally found in the body, the kidneys can remove toxic substances such as barbituric acid, mercury, alcohol, and other medicines.

It is plain to see how essential the kidneys are to the well-being of the body.

One of the familiar conditions which causes the loss of albumin from the body is damage to the glomeruli. This is sometimes called glomerulonephritis.

Uremia is when the kidneys fail to remove the waste products from the blood stream and they accumulate in high concentration in the blood. This condition is serious and sometimes fatal.

The **ureters** are two membranous tubes about 15 to 18 inches long that extend from the kidney pelvis down the back of the abdominal cavity and empty into the urinary bladder. They are about the size of a goose quill.

The **urinary bladder** is a musculomembranous sac located in the pelvis and serves as a reservoir for urine. It empties through the urethra.

The **urethra** is a membranous tube from the bladder through the penis, ending in a meatus or opening. It serves to convey the urine and, in the male, the secretions of the genital glands to the exterior. In the male it is about eight inches long and divided into three parts, the prostatic, the membranous, and the penile portions. The prostatic urethra, about 1 inch in length, is surrounded by the prostate gland. It contains the orifices of the prostatic and the ejaculatory ducts. In this portion the urethra is the largest. The membranous urethra is about one-half inch in length. The penile urethra is the longest and lies along the base of the penis, extending to its external opening, the urinary meatus.

Micturition is the act of voiding urine. This is an involuntary mechanism controlled partly by the will.

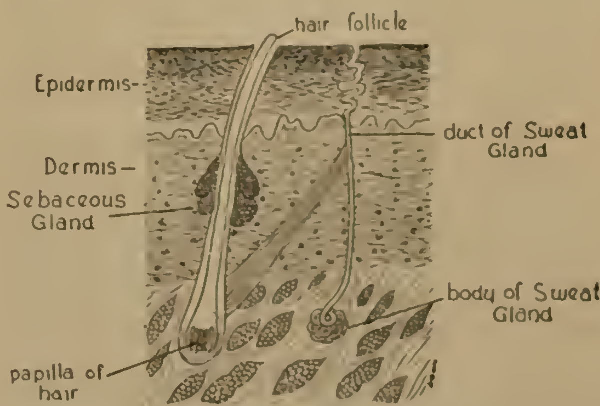

Figure 34.—Structure of the Skin.

Skin

The skin covers almost every visible part of the human body. Even the hair and the nails are outgrowths from it. The skin has much to do with your personal appearance, but the skin is more than something to look at, for it

serves the body in many important ways. It protects the underlying structures. It is a defense against germs. It contains nerves that transmit the sensation of touch, heat, cold, and pressure. It helps to dispose of body wastes. It plays a mighty part in the regulation of body temperature. To better understand how the skin does its work, one should know how it is constructed.

The skin is composed of two chief layers—the outer, the epidermis, and the inner, called the cutis vera or true skin. The outer cells of the epidermis are flat and lifeless, looking like dry, clear, overlapping scales. This scaly layer if unbroken is able to block the passage of almost every known variety of disease germs. The deeper cells are allied and multiply rapidly. Among them are special cells containing pigment, the color and quantity of which are the chief factors in determining your complexion. The newly formed cells push the older cells outward. The nearer they approach the surface, the drier or more scalelike they become and the less life there is in them. It is because of this constant activity of the deeper cells of the epidermis that any injury to the skin, if it goes no deeper than its outer layer, is repaired in a few days, leaving no scar.

The hair and nails are modified epidermis. Their main protective functions are self-evident and need no explanation, but the way in which the eyebrows and eyelashes shade the eyes to keep out dust and other harmful objects is a special evidence of wise planning in the construction of your body.

The sweat glands are coiled tubular glands which lie imbedded in the derma and are surrounded by a small tuft of capillaries. These glands, located partly in the subcutaneous tissue, open by ducts to the surface of the skin. The sweat glands serve as excretory organs, excreting the sweat, or perspiration.

The sebaceous glands are sacular glands, the ducts opening about the hair shaft. These glands secrete an oily substance, sebum, which keeps the skin soft and pliable.

The true skin (cutis vera), besides having nerve endings for touch, heat, cold, and pain, have motor nerves to the blood vessels and secretory nerve fibers to the glands.

Perspiration, or sweat, given off by the sweat glands is a clear, colorless liquid with a slightly acid reaction. It has a salty taste and a distinctive rancid odor, or no odor at all. Perspiration is being secreted constantly, taking place so gradually that it evaporates as fast as it is formed. This is known as insensible perspiration. Under exposure to heat, or exercise sufficient to produce perspiration so rapidly that evaporation does not take care of it, we have what is known as sensible perspiration.

Normally, about one quart of this fluid is excreted daily. However, the amount varies with atmospheric temperature and humidity, and the amount of exercise taken. Sweat consists of water, salts, fatty acids, urea, and carbon dioxide.

THE MALE REPRODUCTIVE SYSTEM

The essential male organs of reproduction are the penis and the testes (testicles). The testes are held in a sac of skin called the scrotum. The male or sperm cells are formed by the testes. They pass into coiled tubular structures called the epididymides, where they are stored. They next travel through long narrow tubes, the ducti deferentia, to short ejaculatory ducts which end in the urethra.

During sexual intercourse the sperm cells, together with fluid secreted by the prostate gland and the seminal vesicles, pass out through

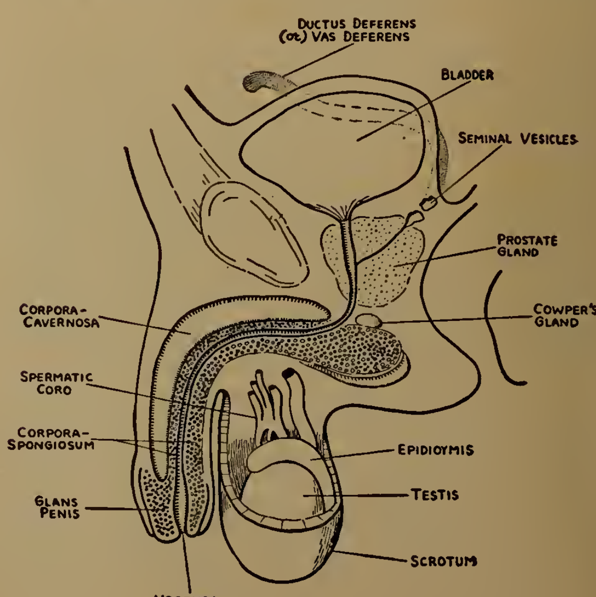

Figure 35.—The Male Reproductive System.

the urethra and are deposited within the vagina of the female. The sperm cells can swim about actively in this fluid and in the mucus covering the lining of the female genital organs. Even though the sperm cells are not deposited near the ovum at first, it may not be long until one of them finds it. They often travel throughout the length of the uterus and fertilize the ovum while it is still in the oviduct.

The testes, prostate, and seminal vesicles are continually at work. The combination of sperm cells and fluid which they produce is called semen. If a man does not have sexual intercourse, semen may be discharged through his urethra every few days. The discharges usually occur at night and are called nocturnal emissions. These have been talked about by quacks to frighten men into thinking that they have some serious disease and need some medicine to cure it. The fact is that such nocturnal emissions are no sign of disease; they do no harm, nor do they weaken a man any more than menstruation does a woman.

Sometimes what appears to be semen will drip from the penis when a man is straining to move his bowels. Quacks also frighten men about this by telling them that they are losing their sexual power. The truth is that this apparent semen is usually nothing but prostatic fluid squeezed out of the gland by pressure within the pelvis due to straining at the stool. In some men with constipation, the pressure of the fecal mass produces the same effect.

Testes

The testes are oval glands suspended in a sac of skin, the scrotum, by the spermatic cord. The function of the testes is to produce spermatozoa (sperm cells) and the male sex hormone. This male hormone is responsible for the development at puberty of the secondary male sex characteristics such as growth of beard, deep voice, and masculine body build.

The epididymis is a division of the testis just outside the gland proper that stores the spermatozoa for long periods of time and eventually transmits them to the ductus deferens.

Ductus Deferens (Vas Deferens)

The ductus deferens is a tiny tube that extends from the epididymis up through the inguinal canal toward the bladder. It carries the spermatozoa to the ejaculatory duct, through which they pass to the urethra.

Seminal Vesicles

The seminal vesicles are two pouches that lie between the bladder and the rectum, and unite with the ductus deferens to form the ejaculatory duct. The vesicles secrete and store a fluid to be added at the time of an ejaculation to the secretion of the testes.

The Ejaculatory Duct

The ejaculatory duct is a short tube that leads into the prostatic uretha. During sexual intercourse spermatozoa from the ductus deferens and fluid from the seminal vesicles are discharged into the ejaculatory duct. The ejaculatory duct then contracts and discharges these substances into the urethra.

The Prostate Gland

This gland is made up of smooth muscle and glandular tissue that surrounds the first section of the urethra. It resembles a horse chestnut in size and shape. The prostate gland secretes an alkaline fluid to keep the sperm mobile and protect them from the acid secretion of the female vagina. This is discharged into the urethra during intercourse.

Cowper's Glands

Cowper's glands (bulbo-urethral) are two pea-sized bodies on each side of the membranous urethra and opening into it. They secrete a fluid that is chiefly mucus and serves to protect the spermatozoa.

Urethra

The urethra is a canal which extends from the urinary bladder to the external opening of the penis. It is the common canal for both the urine and semen.

Penis

The penis is composed of the urethra and three masses of spongy tissue which become swollen with

blood during erection. The enlarged end of the penis is called the glans penis, and at birth is enclosed in a fold of skin called the prepuce or foreskin. The prepuce is often operatively removed, by circumcision, to prevent irritation and make it easier to keep the glans clean.

Spermatic Cords

The spermatic cords are two cords, each consisting of vas deferens, arteries, veins, lymphatic ducts, nerves, and connective tissue. These structures come together in the abdominal cavity and pass into the scrotum through the inguinal rings.

Scrotum

The scrotum is a muscular sac covered by skin, enclosing the testes. This sac provides a cool environment for the testes, which is essential to the growth and maturation of sperm cells.

Semen

The semen is made up of spermatozoa and secretions from the seminal vesicles, prostate, and Cowper's glands. There are millions of sperm cells in each ejaculation, but only one is needed to fertilize a female ovum.

Figure 36.—The Female Reproductive System.

THE FEMALE REPRODUCTIVE SYSTEM

The female reproductive system includes the external genitalia, the vagina, the uterus, the fallopian (uterine) tubes, and the ovaries.

The part of the female reproductive organs that can be seen at the surface of the body is called the vulva. The urethra, through which the urine is voided, opens near the front of a slit in the middle of the vulva. Behind the urethral opening is the vagina, a broad tube averaging about 4 inches long, leading upward to the mouth of the uterus (womb), a pear-shaped muscular organ. From the upper corners of the uterus, small tubes extend sideways toward the ovaries. These tubes are called oviducts or fallopian tubes. The ovaries are glands about the size and shape of almonds.

The essential female organs for reproduction are the ovaries and the uterus. The ovaries produce the ova, one of which normally matures each month. The maturing of female sex cells, or ova, goes on for about 30 years of a woman's life, beginning between the ages of 10 and 15 and stopping between the ages of 40 and 50. The uterus provides a place where a fertilized ovum can be protected and nourished while it is developing into a baby. In making ready to receive and nourish an ovum, the lining of the uterus becomes swollen and soft and has much more blood in it than usual. If the ovum is not fertilized and the blood is not needed for its nourishment, the excess blood and part of the swollen membrane soon escapes from the uterus through the vagina in the form of a bloody discharge. Since this discharge ordinarily occurs about once a month, it is called menstruation.

The External Genitals

These include the labia majora, which are two folds of skin extending from the mons pubis in front to the anus in back. Within these two folds of skin are two smaller folds called the labia minora, or minor lips. The clitoris is a small body composed of erectile tissue located at the point where the two labia minora meet; the vestibule is the space between the labia minora into which the urethral and vaginal orifices open; the hymen is a fold of mucous membrane which extends across the

lower part of the vagina. The mons pubis is the fat pad located in front of the symphysis pubis. It is composed of fatty tissue and covered with skin and hair (in the adult).

The Vagina

The vagina is the muscular canal lined with mucous membrane which extends from the cervix or neck of the uterus to the external genitals. The posterior wall is about 4 inches long and the anterior wall is about 3 inches long. Its lining membrane is greatly folded and is continuous with the inner lining of the uterus. The vagina is capable of stretching widely to serve as a birth canal during the delivery of a baby.

The Uterus

This a hollow, pear-shaped smooth muscle organ lined with a specialized epithelium called endometrium. Normally it is about 3 inches long by 3 inches wide, at its upper widest portion. There are two openings at its upper corners, into the fallopian tubes. It has a tubelike canal in its lower portion, called the cervix, which opens into the vagina.

The Fallopian Tubes

These are two musculomembranous tubes which have free openings in the lower abdominal cavity near the ovaries and terminate by opening into the uterus. Their free ends are shaped like a funnel, surrounded by fingerlike processes designed to help the ovum, when it is released by the ovaries, find its way into the tube and down to the uterus.

The Ovaries

The ovaries are two almond-shaped glands suspended by ligaments in the lower abdominal cavity, one on either side of the uterus. Their prime function is to produce the ova and female hormones, such as estrogens and progesterone, which are necessary for maintaining the menstrual cycle.

Each ovary normally releases an ovum each 56 days, the right and left ovary alternately discharging on ovum every 28 days. Menstruation in most women is therefore a 28-day cycle.

THE NERVOUS SYSTEM

Most body activities are largely under the control of nerves. Trophic nerves are concerned with the growth, nourishment, and repair of tissue. Motor nerves control the action of muscles. Sensory nerves and special sense organs, such as the eyes and ears, keep the body in touch with the outside world, so that it may adjust to its own welfare and safety. The chief business of autonomic nerves is to control and harmonize the work of the vital organs. The entire nervous system is made up of nerve cells, their branches, and supporting tissues. Each nerve cell has a body and one or more branches. Ganglia are groups of nerve cells. Long nerve cell branches are called nerve fibers or axons. When several of these fibers run together in one cordlike bundle, we call the white, glistening cord a nerve, or nerve trunk.

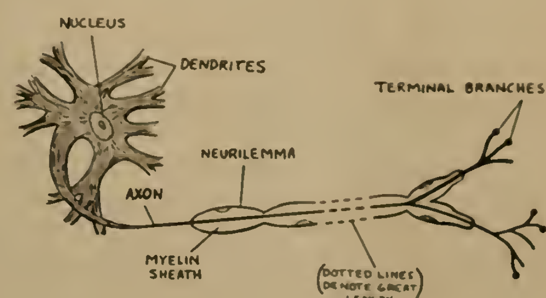

Figure 37.—Diagram of a Motor Neuron.

What is called the central nervous system consists of the brain, the spinal cord, and the nerve trunks and fibers connected with them. The brain is almost entirely enclosed in the skull, but it is closely connected with the spinal cord, which lies in the back bone in a tube formed by the column of ring-shaped vertebrae. From the brain 11 pairs of nerve trunks go out to various parts of the head and neck, and one pair goes down to the chest and the upper part of the abdominal cavity. From the spinal cord 31 pairs of nerve trunks go out to the neck, trunk, and limbs.

Divisions of the Brain

The brain has two main divisions—the cerebrum (large brain), and the cerebellum (small

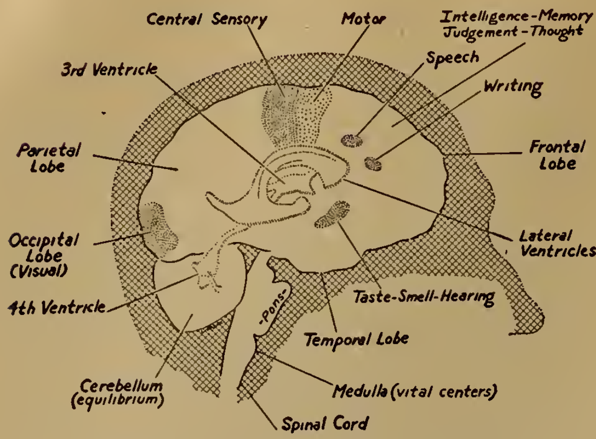

Figure 38.—Functional Areas of the Brain.

brain). The cerebrum occupies nearly all of the cranial cavity. The cerebellum is situated beneath the rear portion of the cerebrum. The cerebrum is concerned with sensation, thought, memory, judgment, reason, and the initiation or management of those motions that we say are "under the control of the will."

The cerebellum is chiefly concerned with bringing balance, harmony, and coordination to the motions initiated by the cerebrum.

The cerebrum is divided into two hemispheres. The outer surface is called "gray matter" because the nuclei of cell bodies make it appear gray. Beneath this layer are connecting axones, or nerve fibers, which form the medulla or central portion of the brain. This is called "white matter." The cortex or surface of the brain is thrown into folds called convolutions, separated from each other by grooves or fissures. Certain areas of the brain are localized for certain functions. For example, in the frontal lobe is the motor area which controls body movements, speech, and writing. The frontal lobe is also the seat of intelligence, memory, and the association of ideas.

Two smaller divisions of the brain, but vital to life, are the pons and medulla oblongata. The pons consists chiefly of a mass of white fibers connecting the other three parts of the brain—the cerebrum, the cerebellum, and the medulla oblongata. It acts as a "bridge," which its name signifies.

The medulla oblongata is the lowest part of the brain, just above the spinal cord. In it are the centers for the control of heart action, breathing, circulation, and other vital processes, such as the control of body temperature.

Inside the brain are small cavities which contain cerebrospinal fluid. The outer surface of the brain is covered with three layers of membranes called the meninges. When these become infected we have what is known as spinal meningitis or cerebrospinal meningitis, depending on whether or not the brain and spinal cord are both infected.

Cerebrospinal fluid is formed by a plexus of blood vessels in the central cavities, or ventricles of the brain. It is a clear, watery solution similar to blood plasma. The total quantity in the spinal system at one time is about 75 cc. and the amount produced daily is about 2,000 cc. It is constantly being produced and reabsorbed. It circulates over the surface of the brain and spinal cord and serves as a protective cushion as well as a means of exchange of food and waste materials.

Functions of the Central Nervous System

The central nervous system is much like a great telegraph system. The brain is its central office. The spinal cord and ganglia are substations. The nerve trunks are cables. The nerve fibers are separate wires, making connections in or between

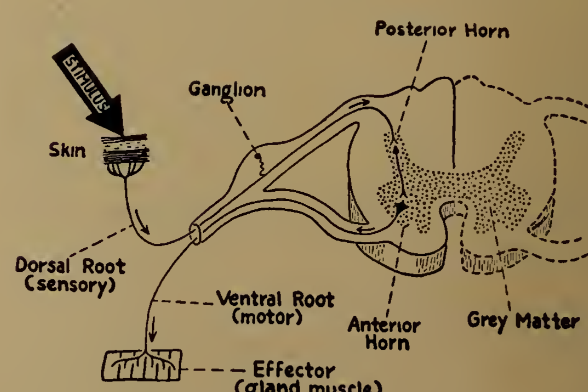

Figure 39.—A Simple Reflex Arc.

the central office and the substations, or going out to all parts of the body. Like the office of the telegraph system, the brain may send out orders in response to messages it receives. It also has the power to send out orders without first receiving messages.

If you touch a hot stove and jerk your hand away from it before you have time to think, you have an example of a reflex. This action takes place on the spinal cord level in what you might term a substation, and is not relayed to the brain. Physicians find reflexes useful in testing the efficiency of the substations of the nervous system, and from them they can also learn much about the central office.

Education consists of changing voluntary actions into reflex actions. When a child is learning to walk, every step he takes is a conscious effort, but in later years he walks without thinking of his steps.

The spinal cord may be thought of as an electric cable containing many wires (nerves) connecting the parts of the body to each other and to the brain. Sensations received by a sensory nerve are brought to the spinal cord and the impulse is transferred either to the brain or to a motor nerve. In the motor nerve the impulse travels out to a muscle or gland and produces an action. The arrangement of these nerves—sensory, association, and motor—is called a simple reflex arc, and the action produced, a reflex action. A reflex act is one which is an involuntary response to a stimulus; you may or may not be conscious of it. If you are conscious of it, it is because the impulse was also relayed to the brain.

Peripheral Nervous System

The peripheral nervous system is made up of 12 pairs of cranial nerves and 31 pairs of spinal nerves, stemming from the brain and spinal cord respectively. These nerves carry both voluntary and involuntary impulses. The cranial nerves are mostly voluntary except for a few fibers going to the eye muscles, the salivary glands, the heart, the smooth muscles of the lungs, and the intestinal tract. The spinal nerves send fibers to all muscles of the trunk and extremities, the involuntary fibers going to smooth muscles and glands of the gastrointestinal tract, genitourinary system, and cardiovascular system.

Cranial Nerves

The cranial nerves are sensory, motor, or mixed (sensory and motor). They are:

1. The **olfactory nerve** (sensory)—the nerve of smell. Conveys the sense of smell from the mucous membrane in the upper nose to the olfactory center in the brain.

2. The **optic nerve** (sensory)—conveys the sensation of sight from the retinal cells of the eye to the visual area of the brain.

3. The **oculomotor nerve** (motor)—controls muscles that move the eyeball and some of those in the iris of the eye.

4. The **trochlear nerve** (motor)—controls the muscle that turns the eyeball down and to the side.

5. The **trigeminal nerve** (motor and sensory)—is divided into three divisions: the ophthalmic (to the eye), maxillary (to the upper cheek), and mandibular (to the jaw and lower face).

6. The **abducens nerve** (motor)—controls the muscle that turns the eye outward.

7. The **facial nerve** (motor and sensory)—controls muscles of the face, scalp, and ears. It contains autonomic motor fibers causing the salivary glands to secrete and carries taste sensation from the front two-thirds of the tongue to the brain.

8. The **acoustic nerve** (sensory)—is the nerve of hearing and equilibrium.

9. The **glossopharyngeal nerve** (motor and sensory)—carries sensations from the pharynx and back third of the tongue. Through the autonomic nervous system, this nerve stimulates the parotid (salivary) gland to secrete.

10. The **vagus nerve** (motor and sensory)—is composed of motor fibers (some of which are parasympathetic) and sensory fibers. It has an extensive distribution, extending down through the neck to the pharynx, larynx, trachea, esophagus, and thoracic and abdominal viscera.

11. The **accessory nerve** (motor)—enervates two muscles of the neck.

12. The **hypoglossal nerve** (motor)—controls the muscles of the tongue.

Spinal nerves arise from the spinal cord and pass out between the vertebrae. There are 31 pairs—8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. The lower spinal nerves going to the lower extremities extend below the level of the spinal cord in parallel strands called the cauda equina since they resemble a horse's tail. They emerge through openings in the sacrum to go down the thigh. Spinal nerves contain all types of sensory and motor fibers of both the

voluntary and autonomic nervous systems. In some regions of the body they interlace in a network called a plexus. The cervical plexus is located in the neck and the brachial plexis in the shoulder; lower are found the lumbar, sacral, and pudendal plexuses.

Autonomic Nervous System

The autonomic nervous system, as its name implies, functions automatically. It is the part of the system which controls the heart, smooth muscle, sweat and digestive glands, and some of the endocrine glands. Its control over these reactions is almost wholly involuntary; yet the behavior of the autonomic system reflects somewhat the activity of the central nervous system, for the two are closely connected. The autonomic nervous system is divided into the sympathetic and the parasympathetic systems.

Sympathetic system.—Numerous ganglia (nerve centers) located just outside the spinal cord beside the vertebra, are the basis of the sympathetic (thoracolumbar) system. These nerve centers connect with the thoracic and lumbar spinal cord and, through the spinal nerves, with the muscles, organs, and glands that they affect.

The parasympathetic system.—The ganglia of the parasympathetic system are located in the midportion of the brain, the medulla oblongata, and sacral regions. For this reason it is sometimes called the craniosacral system. The group in the midbrain and medulla sends out impulses through cranial nerves (oculomotor, facial, glossopharyngeal, vagus). The sacral group stems from the second, third, and fourth sacral nerves.

Function of the autonomic nervous system.—The autonomic nerves belong to a group that is not directly under the control of the brain, but that usually works in harmony with the nerves which are under brain control. Because one function of the sympathetic system is to increase the activity of the body to enable it to meet danger or undergo strenuous physical activity, it has been called the "fight" or "flight" nervous system.

The parasympathetic system acts in opposition to the sympathetic and the two opposing functions tend to keep the body in delicate balance.

Table V.—FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

Sympathetic	Parasympathetic
1. Dilates pupils.	1. Contracts pupils.
2. Lessens tonus of ciliary muscles, so that the eyes are accommodated to see distant objects.	2. Contraets ciliary muscles, so that the eyes are accommodated to see objects near at hand.
3. Dilates bronchial tubes.	3. Contracts bronchial tubes.
4. Quickens and strengthens the action of the heart.	4. Slows the action of the heart.
5. Contracts blood vessels of the skin and viscera so that more blood goes to the muscles where it is needed for "fight or flight."	5. Dilates blood vessels.
6. Relaxes gastrointestinal tract and bladder.	6. Increases contractions of gastrointestinal traet and muscle tone of the bladder.
7. Decreases secretions of glands (exeept sweat glands whicb secrete more).	7. Increases secretions of glands (except sweat glands).
8. Causes contraction of sphincters to prevent emptying of bowels or bladder.	8. Relaxes sphincters so that waste matter can be removed.

SPECIAL SENSES

Special senses include smell, taste, sight, and hearing.

Smell

This is one of the most primitive of the senses. Odor is perceived by stimulation of cells in the olfactory membrane of the nose. Smell is not as well developed in man as in other animals.

Taste

Taste buds are located in the tongue. The sensation of taste is limited to sour, sweet, bitter, and salty. Many foods tasted are actually smelled, and their taste depends upon their odor. We can demonstrate the tastelessness of some foods by holding our noses when we eat them.

Sight (the Eye)

The eye is a specialized organ for the reception of light. The optic nerve conveys the impulses from the retina to the visual area of the brain. The eye is like a camera; it has an opening in the front, called the pupil, for the entrance of light, and a lens behind the opening to focus the rays of light and form an image on the retina in the back of the eyeball. The nerve endings for the sense of sight are shaped like tiny rods and cones standing on end side by side in the retina. They are so sensitive and so close together that points on the retinal image can be seen as separate points

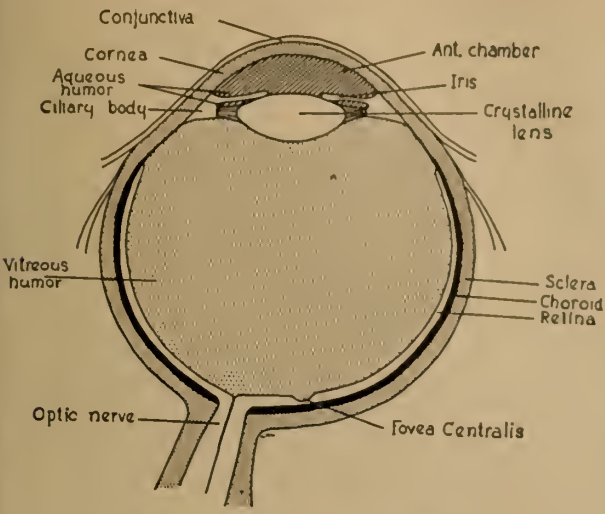

Figure 40.—Diagram of the Eye.

when they are less than $^1/_{10,000}$ of an inch (0.01 mm.) apart.

The eye is divided into an anterior chamber and a posterior chamber with the crystalline lens between. The anterior chamber contains a watery solution called aqueous humor, and the posterior chamber is filled with a jellylike substance called vitreous humor. The eye is composed of three layers of tissue:

1. The **sclera**—the white part of the eye which is the protective outer layer. In front, the sclera is transparent and known as the cornea. Around the cornea the exposed part of the eye is covered with mucous membrane, the conjunctiva.

2. The **choroid** is the middle, vascular layer of the eyeball. The iris, containing radiating and circular muscles which can make the pupil larger or smaller, is the colored portion of the choroid just behind the cornea. The opening in the iris is ca led the pupil.

3 The **retina** is the inner coat of the eye, contai ng the light receptors (rods and cones). The sit f the exit of the optic nerve, lacking rods a nes, is called the "blind spot."

ability to see objects clearly at different es is accomplished by changing the thick- the lens to bring an object into focus. This is called accommodation.

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optic nerve is the sensory pathway for s received in the retina by the rods and

Hearing (the Ear)

The ear is divided into three parts: the external ear, middle ear, and internal ear (fig. 41).

1. The **external** ear is known as the auricle. It is composed of cartilage covered by skin and projects from the side of the head to receive sound vibrations. Sound waves are conveyed through the external auditory canal to the eardrum. The sound waves cause the drum to vibrate. These vibrations are picked up by the inner bones of the ear and transmitted by the auditory nerve to the brain.

2. The **middle ear** is an air-filled space in the skull containing three tiny bones called ossicles. These bones transmit sound waves to the internal ear. The middle ear is connected with the throat by the eustachian tube, which serves to equalize air pressure in the middle ear with that of atmosphere.

3. The **internal ear** contains the receptor organs for hearing. Nerve impulses are transmitted by way of the auditory nerve to the brain.

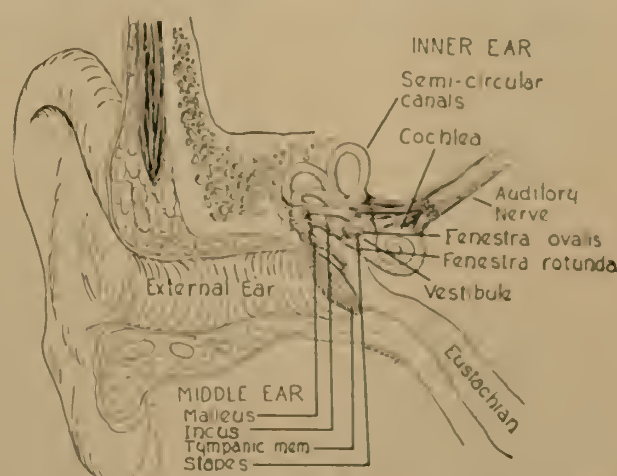


Figure 41.—Diagram of the Ear.

Equilibrium

In each internal ear there are three semicircular canals, a utricle, and a saccule. Changes in the position of the head causes movement of fluid within these canals. This movement is registered on a branch of the acoustic nerve and relayed to the brain, so if you tip your head to one side, you are made aware of this by the nerve of equilibrium from your middle ear.

Special Functions

Speech is controlled by coordinated action of several nerve functions. The speech center is located deep in the brain, and from it nerve impulses pass out to the larynx, which contains folds of mucous membranes called vocal cords. When air is forced from the lungs past these folds, certain sounds are produced, and in conjunction with the movements of the throat, lips, tongue, and teeth, articulate speech results.

Sleep is a period of unconsciousness when the higher physical powers are quiet, but during sleep body activities continue. It is usually considered a period of rest, in which constructive processes build up and repair the body. Certain changes take place during sleep: respiration is slowed; less blood is sent to the brain; and greater amounts go to the extremities. Digestion goes on but at a slower rate during sleep. Body temperature may drop somewhat, and the heart action is slowed.

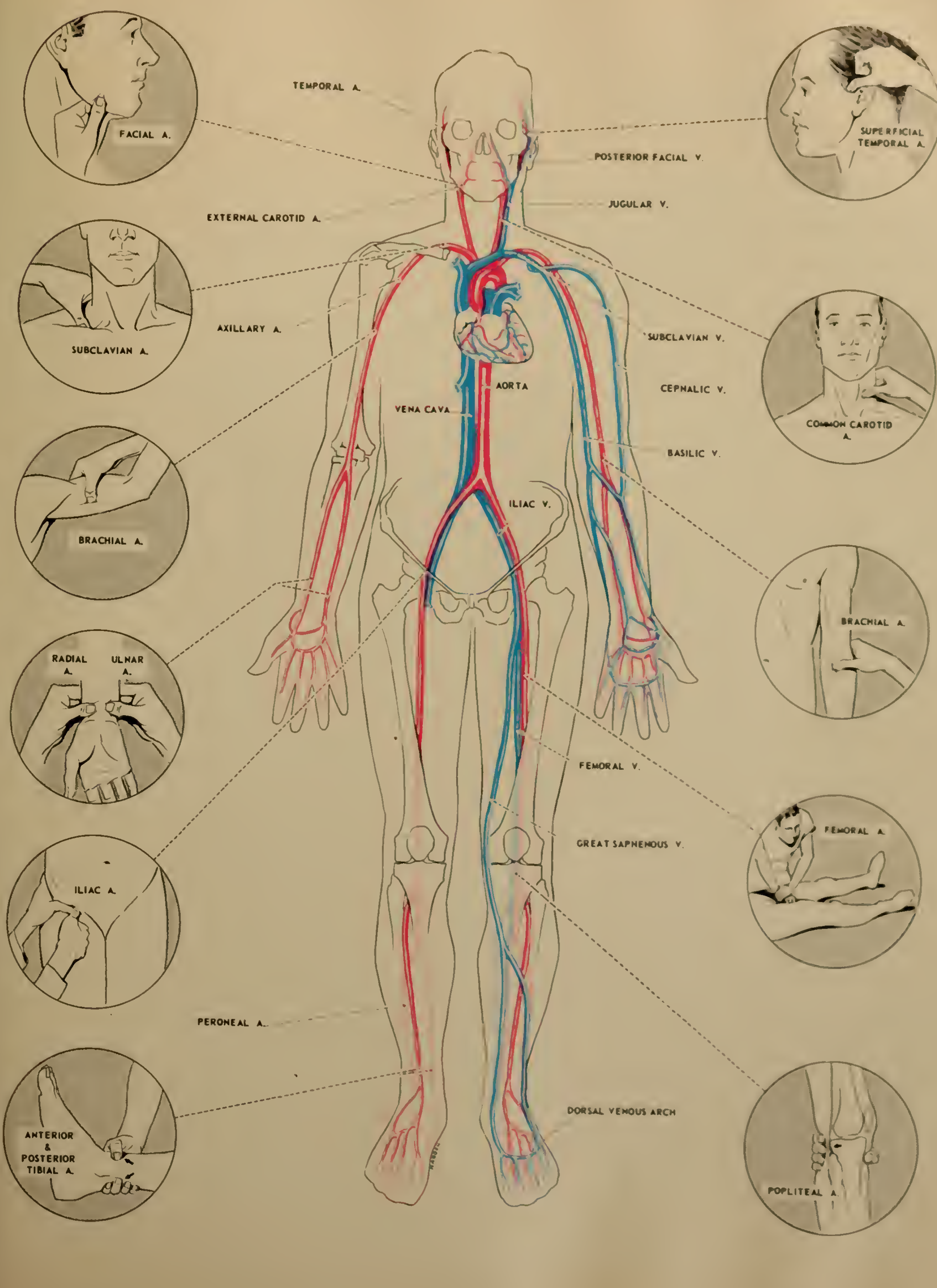
Heat regulation, or maintaining body temperature, is accomplished by controlling heat loss and heat production. Heat is lost through the excreta, expired air, evaporation of sweat, and radiation and conduction from the skin. Heat is produced by burning food within the body, and by muscular activity.

The preservation and elimination of heat is controlled chiefly by the autonomic nervous system, through the nerves to sweat glands and blood vessels. An increase of blood to the skin increases the loss of heat by radiation; heat may be retained by decreasing the amount of blood to the skin.

Fever is an abnormal condition of increased temperature, usually brought about by disease or certain toxic substances. These act upon a heat center in the brain, which influences the body through the autonomic nervous system.

Other Senses

Body tonus and position sense, as well as pain, temperature, and touch are carried through special nerves in the skin and underlying tissues. Other nerve receptors, located in muscles and tendons, are stimulated by changes in tension and pressure, and serve to inform the higher centers regarding the position of parts of the body.


FACIAL A.
TEMPORAL A.
SUPERFICIAL TEMPORAL A.
POSTERIOR FACIAL V.
JUGULAR V.
EXTERNAL CAROTID A.
SUBCLAVIAN A.
AXILLARY A.
SUBCLAVIAN V.
AORTA
VENA CAVA
CEPHALIC V.
COMMON CAROTID A.
BRACHIAL A.
BASILIC V.
ILIAC V.
BRACHIAL A.
RADIAL A.
ULNAR A.
FEMORAL V.
FEMORAL A.
GREAT SAPHENOUS V.
ILIAC A.
PERONEAL A.
DORSAL VENOUS ARCH
ANTERIOR & POSTERIOR TIBIAL A.
POPLITEAL A.

Chapter III

FIRST AID AND EMERGENCY PROCEDURES

INTRODUCTION

First Aid is the emergency treatment of the sick or injured before regular medical or surgical attention can be obtained. It should neither supersede nor take the place of proper medical or surgical attention, and should consist of furnishing temporary assistance to a sufferer pending the arrival of competent medical aid.

The purposes of first aid are:

1. To save life.
2. To prevent further injury.
3. To preserve resistance and vitality.

A real knowledge of first aid and its purposes, when properly applied, may mean the difference between life and death, between rapid recovery and long hospitalization, between temporary disability and permanent injury.

Knowing when to, what to, and how to apply first-aid measures for the many and various conditions that confront the hospital corpsman in emergency requires a great deal of knowledge and a continual studious effort on his part to keep abreast with the changes in and the newer concepts of first aid treatment.

Minor Surgery is that part of surgery that includes procedures not endangering life. It includes the application of bandages, splints, dressings and sutures, counterirritation, cauterization, and similar simple surgical measures.

General Procedures in Case of Injury

Observe the following rules:

1. **Keep** the patient lying down with the head level until his injuries have been determined.
2. **Examine** the patient for hemorrhage, cessation of respiration, and evidence of poisoning. These conditions take precedence in this order over everything else and demand immediate treatment.
3. **Remove** enough clothing to get a clear idea of the extent of the injury. Preferably rip the clothing along the seams, but cut it if necessary. Removing clothing in the usual way may do great harm, especially in fractures. Do not remove too much clothing; exposure to cold may precipitate the condition of shock.
4. **Do not** get excited. Act quickly but efficiently. Decide as soon as possible what has to be done and which one of the patient's injuries needs attention first.
5. **Keep** the patient comfortable. This can be done while the patient's injuries are being cared for. A blanket over the patient may do him as much good as the dressing one applies to his wounds.
6. **Avoid** allowing the patient to see his injury. Assure him that his injuries are understood and that he will get good care. In some cases a cigarette will make a patient feel better. These little things are important in determining a patient's final outcome and preventing shock.
7. **Do not** touch open wounds or burns with your fingers or other objects. This may cause serious infections and may cost the patient his life.
8. **Do not** try to give an unconscious patient liquids.
9. **Do not move** a patient until the extent of his injuries has been determined.

HEMORRHAGE

Hemorrhage, or bleeding, is the escape of blood from the arteries, veins, or capillaries because of a break in their walls.

The average adult body contains about 5 quarts of blood. One pint can usually be lost with no harmful effects. This is the average amount given by blood donors. The rapid loss of about 1 quart will produce symptoms listed below, the greater the loss the more pronounced the symptoms. The loss of a quarter of the blood volume is dangerous, the loss of one-half of the blood volume is usually fatal.

Spontaneous hemorrhage (not caused by injury).—Caused by conditions such as straining, coughing, and arterial or venous hypertension.

Traumatic hemorrhage (caused by external forces).—Caused by conditions such as cutting with sharp instrument, heavy blow of an object, compound fracture, and traumatic amputation.

Arterial hemorrhage.—Blood is bright red, gushes forth in jets or spurts that are synchronized with the pulse.

Venous hemorrhage.—Blood dark red, escaping in a steady flow.

Capillary hemorrhage.—Blood intermediate in color, oozes from the wound.

Symptoms and Diagnosis

External hemorrhage can be seen and is easily recognized. Internal, or concealed, hemorrhage is sometimes difficult to diagnose. Symptoms are easily confused with those of shock.

The following symptoms are usually present both in internal and external hemorrhage, the degree depending on the amount and rapidity of blood loss:

1. Skin pale, moist, clammy.
2. Temperature may be subnormal.
3. Pulse rate will usually be increased, feeble, easily compressible and lost.
4. Blood pressure may be lowered.
5. Pupils of eye usually dilated and slow reacting.
6. Tinnitus—ringing in the ears.
7. Restlessness and twitching; displays anxiety.
8. Patient complains of thirst.
9. Air hunger, with yawning.
10. Impaired vision; the greater the loss of blood the greater the vision will be dimmed.

In addition to the above causes, concealed hemorrhage may be caused by punctured wounds; wounds that have been closed by sutures, especially deep wounds; heavy blows rupturing internal organs; spontaneous rupture of internal vessels; and numerous other causes that will be discussed later. These factors must be borne in mind in examining an individual with the above symptoms.

Treatment

The following are various methods used in controlling hemorrhage:

1. Place patient at rest, administer morphine (one-fourth grain).
2. Elevate the part if an extremity.
3. Manual pressure over pressure points.
4. Cold applications.
5. Local hemostatic (styptic).
6. Direct or indirect pressure, using pressure bandage or tourniquet.
7. Clamping or ligation of vessels.
8. Suture wound.

NOTE.—Do not disturb a clot while checking bleeding.

Arterial hemorrhage.—Requires prompt and decisive methods particularly in cases of hemorrhage from the large arteries. Manual pressure may be resorted to until a tourniquet is made available. The tourniquet can only be used on the extremities. Pressure must be between the wound and the heart. Plate No. I illustrates the major pressure points. At these points the arteries may be compressed more easily against a bone. This plate and the inserts should be studied well, and the points shown impressed on the mind. The pulse can usually be felt with the fingers at the pressure points.

A tourniquet is a constricting band. There are many kinds. The principle of all tourniquets is a pad or other object over the artery, a band around the limb, and some means of tightening the band. Any round, smooth object such as a stone, rifle shell, or roller bandage may be used and any material such as a neckerchief, belt, or bandage is used as the band. The object—to compress the artery to close it. Place hard object over pressure point, tighten band until arterial hemorrhage stops. There is great danger in the use of a tourniquet. Permitted to remain in place with circulation cut off, the part below the tourniquet quickly becomes swollen and painful, and if permitted to remain long enough may cause gangrene and consequent loss of the part. The tourniquet should be loosened every 15 minutes. If bleeding recurs, tighten immediately. If patient is to be transported, do not cover the tourniquet with a blanket without being certain that the attendant knows of the tourniquet. Never cover a tourniquet with a bandage or dressing. Never use a tourniquet if other means will stop the hemorrhage.

Arterial hemorrhage, especially from the femoral artery, is often difficult to stop with a tourni-

quet. If this large artery is severed, only a matter of minutes remain in which to work. Drastic measures are essential. If nothing else is available, reach in the wound with the thumb and forefinger, grasp the end of the artery, twist a few times, and either hold until aid arrives or tie with a piece of string. If sterile items are at hand use them, but do not wait if they are not. The danger of infection must be set aside to save life. If no other means are available and the artery cannot be reached for ligation (tying off), and a tourniquet will stop the hemorrhage, then use it, even though it may have to remain in place for a long period of time. It is better to chance the loss of a limb of the patient than his life.

Venous hemorrhage.—This may be controlled by the use of dressing and tight bandage over the dressing An extremity may be tightly bandaged from the toes or fingers up to the bleeding point. This with elevation of the part may stop the bleeding.

NOTE.—In the majority of cases a pressure dressing will suffice to control external hemorrhage.

Capillary hemorrhage.—This can usually be controlled with a compress and bandage. It may be necessary to use a styptic: alum, adrenalin, or tincture of ferric chloride being the more common.

Internal, or concealed hemorrhage.—May be caused by deep wounds, heavy blows that rupture internal vessels, certain diseases and conditions. The symptoms will be as listed except ability to see the hemorrhage. Recent history of trauma will be an indication. It must be remembered that shock gives symptoms similar to those of internal hemorrhage. If there is much loss of blood, shock will develop. There may be shock present from a heavy blow. This requires the services of a medical officer as soon as possible.

First Aid Treatment

1. Place the patient at rest.
2. Apply ice bag over part if it is certain that hemorrhage is present.
3. Keep patient quiet.
4. Administer morphine.

Lung hemorrhage (hemoptysis).—May result from wound of the lungs, more often from disease. Usually starts with fit of coughing. Expectorates bright red blood, usually frothy.

Treatment:

1. Place patient at rest, absolutely quiet.
2. Ice bag to chest.
3. Medical officer summoned at once.
4. Small pieces of cracked ice may be given by mouth.
5. No stimulants of any kind.
6. Patient may be turned on affected side to prevent the blood from entering the unaffected lung.

Stomach hemorrhage (hematemesis).—Patient usually vomits, blood is usually dark colored, clotted, and may be mixed with food. Blood may have been swallowed from nosebleed. Inquire as to recent trauma of any kind, including extracted teeth.

Treatment.—Is same as for hemorrhage of lungs except ice bag is applied over upper part of abdomen. Morphine sulfate ($\frac{1}{4}$ grain) may be given.

Nasal hemorrhage from nose (epistaxis).—

1. Have patient remain quietly in sitting position. Loosen collar.
2. Place cold packs at back of head.
3. Instruct patient to breathe through the mouth, and not to blow the nose.
4. Nostrils may be packed with a piece of cotton or gauze that has been dampened with adrenalin, 1 : 1000 solution.
5. If these methods fail, summon a medical officer.

Hemorrhage from a compound fracture may be controlled by pressure applied to main compression point of the area involved until clot formation appears, or by direct pressure over the area with sterile compresses.

ASPHYXIA

Asphyxia is a condition where respiration, or breathing, has ceased. It may be the result of either abnormal physiological or physical causes. When due to the latter it may be spoken of as suffocation. Among the physiological causes of asphyxia are: Lack of stimulation of the respiratory center, and inability of the blood to absorb oxygen from the lungs or to effect the normal exchange of gases in the body tissues. In asphyxia resulting from physical causes, the lungs are deprived of air because of stoppage of the air passage mechanically, as by water in drowning, by a foreign body,

by a diphtheritic membrane extending into the larynx, by a swelling of the mucous membranes following inhalation of live steam or an irritating gas, by a constricting band around the neck compressing the trachea; or because of the presence of irrespirable gases in the air.

Treatment: First remove the cause or remove the patient from the cause, then give artificial respiration, and later treat for shock.

Artificial respiration is used to induce breathing in persons whose respiration has stopped. The common causes of respiratory failure where artificial respiration has value are: Drowning, suffocation, electric shock, and poisoning by illuminating gas or carbon monoxide. Artificial respiration is also used occasionally in certain illnesses, such as poliomyelitis. Poison gases and nerve gases used in warfare may cause respiration to cease. Attempts to start respiration after breathing has stopped are made either by mechanical or manual methods. Mechanical methods require the use of machines that usually are not on hand when most needed. Manual artificial respiration, which can be conducted by anyone familiar with the methods, can be started immediately and can be continued until breathing has started or until mechanical respirators become available.

Instructions for Artificial Respiration

Certain general principles must always be kept in mind in performing any method of artificial respiration.

1. Time is of prime importance. Seconds count. Do not take time to move the victim to a more satisfactory place; begin at once. Do not delay resuscitation to loosen clothes, warm the victim, apply stimulants, etc. These are secondary to the main purpose of getting air into the victim's lungs.

2. Quickly place the victim in the prone position, that is, on his abdomen, with the face turned to one side, the elbows bent, and the cheek resting on the back of the hand.

3. Quickly sweep your fingers into the victim's mouth, removing froth and debris and drawing the tongue forward.

4. Begin artificial respiration and continue it rhythmically and uninterruptedly until spontaneous breathing starts or the patient is pronounced dead.

5. As soon as the subject is breathing for himself, or when additional help is available, see that the clothing is loosened (or removed if wet) and the patient is kept warm. However, do not interrupt the rhythmical artificial respiration to accomplish these measures.

6. If the victim begins to breathe on his own, adjust your timing to assist him. Do not fight the victim's attempt to breathe. Synchronize your efforts with his.

7. Do not wait for a mechanical resuscitator, but when an approved model is available use it. A well-performed "push-pull" type manual method is immediately available and effective and accomplishes adequate ventilation. The mechanical resuscitation is no more effective than a properly performed "push-pull" manual technique. The most important adavantage of good mechanical resuscitators is that they require less skill to operate, are not fatiguing, and can furnish 100 percent oxygen. There are other advantages. Since the resuscitator need only be applied to a patient's face, it can be employed when physical manipulation of the body is impossible or would be harmful, as during surgical procedures, in accident cases with extensive burns, broken vertebrae, ribs, arms, etc., and for victims trapped under debris of excavations, overturned vehicles, etc., and during transportation of the victim. Furthermore, some resuscitators signal when the airway is obstructed and provide an aspirator.

Arm-Lift Back-Pressure Method

1. **Position of subject.**—Place the subject in the face-down prone position. Bend his elbows and place his hands one upon the other. Turn his face to one side, placing his cheek on his hand.

2. **Position of the operator.**—Kneel on either the right or left knee, at the head of the subject, facing him. Place the knee at the side of the subject's head close to the forearm. Place your hands on the flat of the subject's back in such a way that the heels of the hand lie just below a line running between the arm pits. With the tips of the thumbs just touching, spread the fingers downward and outward.

3. **Compression phase.**—Rock forward until the arms are approximately vertical and allow the

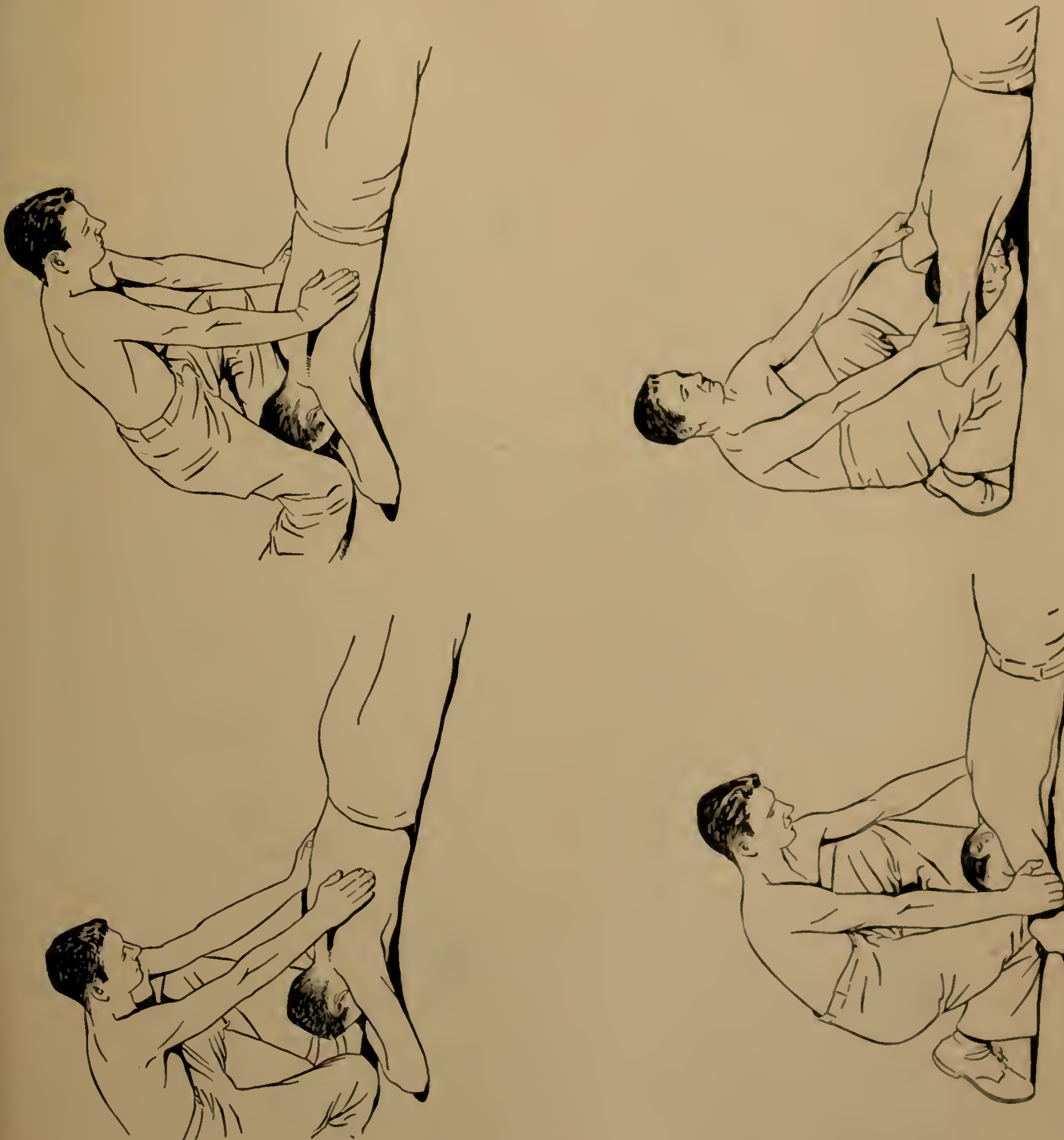


Figure 43.—Arm-Lift Back Pressure Method of Artificial Respiration.

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Figure 44.—Hip-Lift Back Pressure Method of Artificial Respiration.

weight of the upper part of your body to exert slow, steady, even pressure downward on the hands. This forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward on the back.

4. **Expansion phase.**—Release the pressure, avoiding a final thrust, and commence to rock slowly backward. Place your hands upon the subject's arms just above his elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the subject's shoulders. Do not bend your elbows, and as you rock backward the subject's arms will be drawn toward you. Then drop the arms gently to the ground. This completes the full cycle. The arm-lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.

The cycle should be repeated 12 times per minute at a steady, uniform rate. The compression and expansion phases should occupy about equal time, the release periods being of minimum duration.

Additional Directions

It is all important that artificial respiration, when needed, be started quickly.—There should be a slight inclination of the body in such a way that fluid drains better from the respiratory passage. The head of the subject should be extended, not flexed forward, and the chin should not sag lest obstruction of the respiratory passages occur. A check should be made to ascertain that the tongue or foreign objects are not obstructing the passages. These aspects can be cared for when placing the subject in position or (shortly thereafter) between cycles. A smooth rhythm in performing artificial respiration is desirable, but split second timing is not essential. Shock should receive adequate attention, and the subject should remain recumbent after resuscitation until seen by a physician or until recovery seems assured.

The Hip-Lift Back-Pressure Method

The hip-lift method is used when the arm-lift method is not practicable, such as fractures, burns, etc.

1. **Step 1.**—Place the patient in a prone position, face down. The arm, on the side toward which the face is turned, is extended beyond the head, and the other is bent at the elbow and the hand or forearm is placed beneath the head.

2. **Step 2.**—The operator then kneels on one knee (whichever is the most comfortable) astride the patient's thighs, facing toward the head, and places the palms of his hands on the lower part of the thorax, the little fingers touching the lowest rib and the ends of the fingers just out of sight. Then keeping the arms straight, the operator swings his body slowly forward, causing the hands to press upward and inward. This compresses the abdomen and the lower part of the thorax, forces out the air in the lungs, and produces an expiration. At the end of the forward swing, the operator's shoulders should be directly above the heels of the hands. Hold the pressure momentarily.

3. **Step 3.**—Then quickly bring the hands back along the sides of the patient to the hips, grasping the hips and pulling upward in a single motion. At the end of the upward motion the hips are released and the operator goes back to his original position. This procedure is completed 12 to 15 times a minute.

The Schaefer Method

The following is the prone pressure method of artificial respiration.

1. Place the patient face down on blanket, head at side, cheek resting on hand. Straddle both legs of patient.

2. Extend the arms with the hands placed on both sides of the chest with the thumb close to fingers and little finger over the last rib.

3. Rock forward with elbows straight, bringing your weight on the patient's chest. Then release pressure and return to original position. Repeat 12 to 15 times per minute.

Figure 45.—The Schaefer Method of Artificial Respiration.

The Eve Resuscitation Method

The following is the proper procedure for administering the Eve resuscitation method.

1. Place patient on board or litter, arms extended and wrists and ankles secured.

2. Lift and lower each end of litter alternately, maintaining a rate of 12 to 15 complete cycles per minute.

3. Continue this until breathing is adequately established or death is apparent.

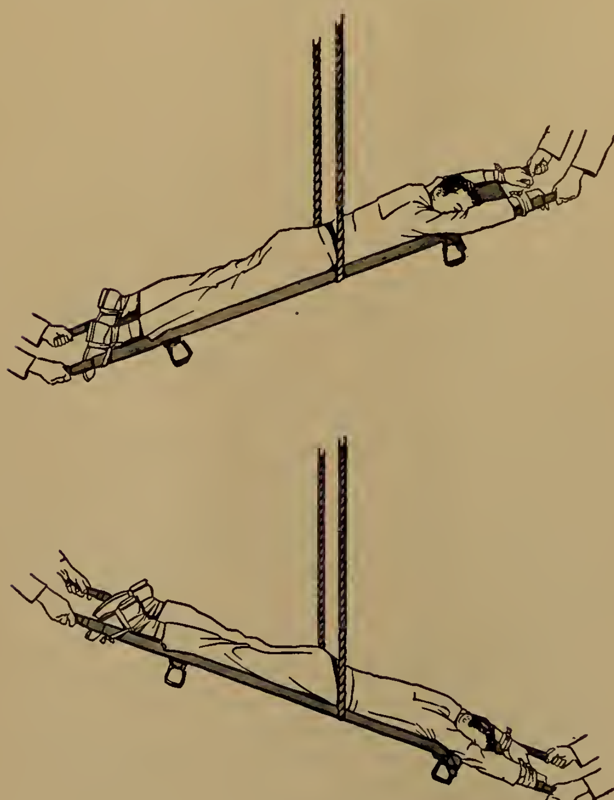


Figure 46.—The Eve Method of Artificial Respiration.

Lightning and Electric Shock

Lightning and electric shock may cause instant death or may cause unconsciousness, cessation of breathing, and all degrees of burning. Patients who have been shocked by an electric current must be removed as quickly as possible from contact with the source of electricity. This removal must be accomplished without the rescuer coming into contact with the electricity. If the patient has ceased to breathe, artificial respiration should be instituted and maintained until all hope of recovery is gone or normal breathing has commenced. Electric burns should be treated in the same manner as any burn.

Poison and Nerve Gases

For treatment of asphyxiation from poison and nerve gases refer to the chapter on Chemical Warfare.

MECHANICAL RESUSCITATORS

A mechanical resuscitator, now available for issue, is listed in the catalogue of Medical Matériel as "Resuscitator, Inhalator and Aspirator, Portable; Intermittent positive and negative pressure, automatic cycling. Complete with adult and child face masks and airways, in carrying case."

Every hospital corpsman, who may have occasion to use this resuscitator, should carefully study the booklet of instructions on operation and care of the resuscitator in order to be able to operate it at a moment's notice.

This type of apparatus is used as (1) resuscitator (2) inhalator (3) aspirator, under the following conditions:

Used as resuscitator.—When there is no breathing, such as in drowning. When breathing is difficult, slow or shallow, as in acute cases of asthma.

Used as inhalator.—When the recipient requires more oxygen than is normally in the air, due to such conditions as shock; poor circulation of blood principally caused by one or more heart conditions; damage to lung tissue caused by irritating fumes or gases.

Used as aspirator.—It clears the mouth, nose, and throat of mucus or blood so that the oxygen can reach the recipient's lungs (the aspirator can be used during resuscitation or inhalation if the air passages become clogged with mucus or blood).

The apparatus consists of oxygen tank, with couplings; pressure gage; rubber diaphragms in metal resuscitator; connecting hose; face masks, both adult and infant size (these masks are made of plastic with a soft rubber cushion base that can be made airtight and at the same time transparent so that it can be seen through. The patient's face can be watched without having to remove the mask). Wire metal airways for both adults and

infants: rubber catheter for use with aspirator; aspirator; extension hose to enable the operator to work in tight places or at a distance of about 25 feet from the oxygen tank.

To operate.—Place patient in supine position (on back, face up). The patient's ears should be in line with shoulders, not forward or backward.

If it is desired to prevent increased blood flow to the head as in certain heart conditions, elevate the head and shoulders.

In other cases where it is desirable that the blood go to the head, the lower extremities should be elevated and the head and shoulders lowered, as in cases of shock.

Remember that these are desirable positions. The resuscitator can be used with the patient in almost any position. Circumstances must dictate this.

The operator's left hand should hold the jaw up and slightly forward to help keep the throat passage open.

The tongue should lie in the center and flat on the floor of the mouth. The metal wire airway, if used, is placed on top of and in the middle of the tongue, to keep the tongue from curling backward over the windpipe opening.

Before starting resuscitator, remove any obstructions present in the mouth or air passages such as false teeth, gum, tobacco, blood, or mucus. Use aspirator for the latter.

If possible, the operator should work from behind the patient's head in operating the resuscitator and observing the patient.

Hold the jaw up with left hand. With the right hand place the mask from the side of the face over the patient's nose and mouth. Keep the mask in place by placing the thumb over the cushion at the bridge of the nose, the index and middle finger over the plastic mask and cushion just over the jaw. The ring and little fingers should be under the jawbone to hold it up and slightly forward.

The mask is in place if the indented part of the cushion rests on the bridge of the nose and its edge fits snugly all around.

The mask must be airtight on the patient's face or oxygen will be lost. The soft rubber cushion on the mask aids in making a seal to prevent oxygen loss.

Turn indicator to the amount of oxygen required.

To start oxygen flow attach the metal resuscitator to the face mask and push the hose into the knurled ring on the resuscitator. This will start the oxygen flowing and the operation is then automatic.

Keep the air passages free of mucus by use of the aspirator. Aspirator is attached to the oxygen hose in place of the resuscitator and releasing the trigger on the aspirator causes the oxygen to pull a vacuum in the aspirator.

With this respirator, the patient cannot be given too much oxygen. Only that which can be used is released at the time of use. Even with the valve wide open to let the maximum amount of oxygen into the respirator, only that which is being used will pass through the respirator.

Warnings and Precautions in the Use and Care of the Aspirator

Keep oil and grease away from the tank valve and resuscitator yokes. Never change tanks with oil or grease on hands.

Never boil or autoclave plastic face masks.

Never pull on hose attached to knurled ring of resuscitator. It never comes completely off. This hose snaps out of ring to turn off oxygen, but it is not removed.

When the apparatus is stored, make sure:

That it has been thoroughly cleaned. (Airways, masks and cushions, wash with warm soapy water, rinse well and dry. Powder cushions lightly. Keep cushions inflated.)

That it has been checked thoroughly. See that all parts are working.

See that all parts are stored in the proper place.

Test the machine at least once each month. Do not merely open the case, but put the parts together and actually run the machine for a minute or two. Be certain that the oxygen pressure gage shows sufficient oxygen in the cylinder.

This is an excellent time to hold instruction in the use of the apparatus. Be certain that all hands have an opportunity to actually operate the apparatus.

Make certain that the booklet of instruction is kept in the holder provided for it, in the lid of the carrying case, and that all personnel

thoroughly read and understand these instructions.

Remember that you and the apparatus are a life-saving team. Both must do a good job. Unless the operator has a thorough knowledge of the apparatus and knows how to operate it properly, neither the apparatus nor the operator can do a good job.

SHOCK

Shock is the sudden depression of the physical and mental processes of the body resulting from most injuries (some degree of shock follow all injuries, it may be slight, lasting only a few minutes, or it may be prolonged). The nervous system which controls these vital functions may be likened to a system of electrical wiring. If too heavy an electrical current is made to traverse the wires in an electrical system they are likely to be burned out, or fuses blown. Similarly, if too violent impulses traverse the nerve paths in the body, there may be death from complete non-functioning of the nervous system, or there may result a much milder condition in which there is only partial functioning of the same. As the nervous system controls the mental and physical processes of the body, so in shock they are all more or less affected. Practically any impulse traversing the nerve paths, if severe enough, may cause shock. There is emotional shock, where the impulses originate in the brain; traumatic shock, which results from a severe blow in the solar plexus or testicle, or from crushing or cutting a large nerve trunk, or from some severe injury; and electrical shock, resulting from a heavy electric current traversing the nerve paths.

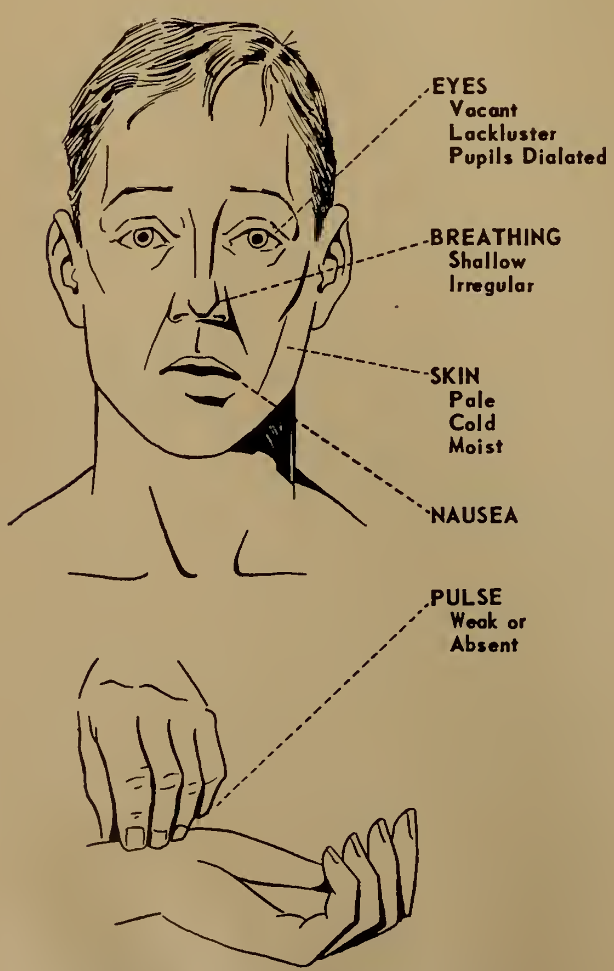


Figure 47.—Look for These Symptoms in Shock.

One of the main effects of too violent impulses on the nerve track is the loss of nerve control over the blood vessels, resulting in the circulating blood collecting in the veins, especially the large veins of the abdomen and depriving the brain and other parts of the body of their normal supply. More or less, shock occurs from all injuries, depending upon the stability of the nervous systems of individuals; what might cause a mild case of shock in one would cause a severe case in another.

Symptoms of Shock

1. In early shock feeling of weakness, faintness, dizziness, and often nausea.
2. General typical appearance—at first pale, then ashen. Skin cold and clammy from perspiration. In some cases there is cyanosis or lividity due to the delayed filling of the surface blood vessels, especially in the arms and legs.
3. Expression of acute anxiety, restlessness and apprehension.
4. Complains of thirst.
5. Pupils dilated and eyes have a glassy or vacant stare.
6. The heart sounds are faint and distant.
7. Rising pulse rate. In severe cases it may rise to 160 or more per minute, becoming at the same time weak and thready.
8. Respirations faint, shallow, and rapid.
9. Falling blood pressure, the blood pressure drops as a result of the depression in circulation, this is one of the most constant features of a de-

veloping shock. There is a so-called "dangerous blood pressure level" in the neighborhood of 50 mm. of mercury. If a patient's blood pressure remains below this critical level for a number of hours, the resulting lack of blood with oxygen to the brain and other body tissues may produce irreparable damage after which no form of treatment can save the patient's life.

10. At first the patient appears calm and rational, but as the state of shock progresses and there is deficient circulation to the brain, greater stimuli are necessary to produce any response from the patient. Finally a stupor may set in (patient is in a state of mental confusion).

It is of paramount importance that the treatment of shock be commenced at the earliest possible moment so as to limit its severity to a minimum. Prolonged deep shock may produce such extensive damage that subsequent treatment cannot save the patient's life. First aid treatment should consider the prevention as well as the therapy.

Emergency Treatment

1. **Place** the patient in the proper position which should be a horizontal position with head lowered. The circulation in shock is unstable and placing the patient in this position provides for a flow of blood to the brain. Rest and quiet are essential. (Treat the cause at the same time.)

2. **Keep** the patient warm by use of blankets. A warm drink may be given the patient if he is conscious. Do not warm the patient with artificial means, such as hot water bottles, as by warming the body by this method the blood is drawn to the surface into the dilated blood vessels and away from the vital organs.

3. **Morphine:** If the patient is conscious give ¼ grain of morphine by hypodermic injection (one syrette contains ½ or ¼ grain). If the restlessness and pain continues after a reasonable length of time (30 to 45 minutes), a ¼-grain additional dose may be necessary for the relief of pain and is essential to prevent further shock; however, in the average case it will not be necessary to repeat the morphine at less than 4-hour intervals, and then only if the pain demands. Caution must be observed in repeating morphine injections as an overdose will cause a depression of the depth and rate (under 15 per minute) of respiration through direct effect on the respiratory center. Contraction of the pupils (pin point in size) which may be very marked, is a valuable warning of over dosage. Patient's with head injuries who are conscious and in pain may be given Phenobarbital 1½ grains. Morphine should *never* be given in the case of *head injuries*.

NOTE.—All patients given morphine in the field should be marked with an "M" on the forehead or this information must be accurately recorded on the emergency medical tag.

4. **Hemorrhage.**—Bleeding must be stopped at once by methods described under hemorrhage.

5. **Fluid replacement.**—Fluids to re-establish an effective blood volume and pressure to normal should be supplied as soon as possible. Normal blood plasma injections are most universally used. Serum albumin, which comes in smaller containers than plasma, is available. If neither of these fluids are available, a solution of 9 grams of sodium chloride in 1,000 cc. of sterile distilled water should be given intravenously. The use of whole blood in most circumstances is the ideal fluid for this purpose, but because of its nature it is difficult to preserve, supply, and administer. The administration of whole blood is limited to medical officers.

Plasma

In estimating the dosage of plasma it is necessary to consider the extent and degree of the injury as well as the age and condition of the patient.

1. Patients exposed to obvious cause for shock but clinical symptoms not yet apparent, 250 to 500 cc.

2. Patients who give indication of early, moderate shock, 250 to 750 cc.

3. Patients in severe shock, 750 to 1,500 cc.

4. Extreme shock (usually long untreated), 1,500 to 3,000 cc.

The first 250 to 500 cc. administered as rapidly as possible. Repeat as often as necessary.

5. Severe burn cases, whether in great shock or not, give at least 1,500 cc. as shock is sure to develop and will overwhelm the patient before a sufficient amount of plasma can be given.

NOTE.—A reasonable length of time between doses of plasma should be allowed to observe the patient's reactions; if the reaction is favorable it is sometimes unwise to give more plasma at that time.

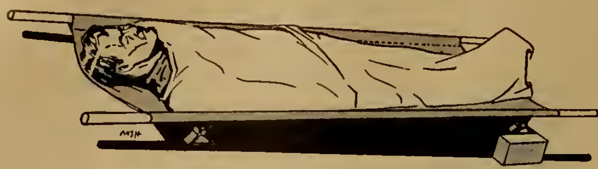


Figure 48.—Shock Position.

Morphine Syrette

This syrette is composed of a collapsible metal tube with a hypodermic needle attached, a stylet in the needle, and the needle covered with a plastic tube. The needle has been sterilized. The collapsible tube contains either ½ or ¼ grain morphine tartrate. (See fig. 49.)

To use: Break seal on bottom of or unscrew the plastic tube and remove. Grasp stylet at top and push into the tube until circle at top of stylet is stopped by guard. Remove stylet and use as hypodermic syringe, with sterile technique.

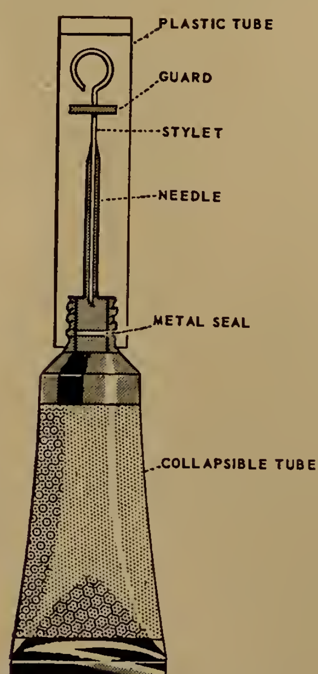


Figure 49.—Morphine Syrette.

BLOOD PLASMA

Normal human plasma dried, or as commonly referred to, blood plasma, is issued as a unit. This unit consists of one cardboard box, which contains two cylindrical tins, hermetically sealed. A key for opening is attached to the bottom of each tin. Directions for mixing and administration of blood plasma are printed on the tin. Sterile needles and tubing for proper administration are sealed in the tins.

1. Open metal cans with attached keys.
2. Remove plasma and water bottles. Cleanse stoppers with alcohol.
3. Remove wrapper from double-ended needle and remove glass tube from one end of needle. Remember these needles are sterile, handle accordingly.
4. With water bottle in upright position insert uncovered end of double-ended needle through stopper into the water bottle.
5. **Caution:** The bottle containing the dried plasma contains a vacuum to pull the water into the plasma bottle. If the needle is placed in the plasma bottle first, the vacuum will be destroyed, and much valuable time will be lost in getting the water into the plasma bottle.
6. Elevate free end of airway assembly to prevent water from wetting cotton filter in airway.

Caution.—If cotton in airway filter becomes wet—remove it.

7. Remove glass tube from other end of double-ended needle. Invert water bottle and insert needle through stopper into the plasma bottle.
8. Allow water to be drawn into plasma bottle.

Caution: If vacuum in plasma bottle is lost, apply pressure in water bottle by forcing air into airway tube. If this method fails, remove stoppers and pour water into plasma bottle. Replace stopper on plasma bottle and continue immediately.

9. After water is added, double-ended needle is removed from plasma bottle.
10. Shake plasma bottle until plasma is completely dissolved.
11. Remove coverings from short needle attached to intravenous set and insert through stopper on plasma bottle.
12. Withdraw needle of airway assembly from water bottle and insert through stopper into plasma bottle.
13. Invert plasma bottle and suspend it for administration.
14. Fix glass end of airway assembly with the suspension tape above the inverted plasma bottle.
15. Remove wrapper from observation tube and intravenous needle.

16. Attach intravenous needle to tube and remove glass from needle.

17. Allow plasma to fill rubber tubing.

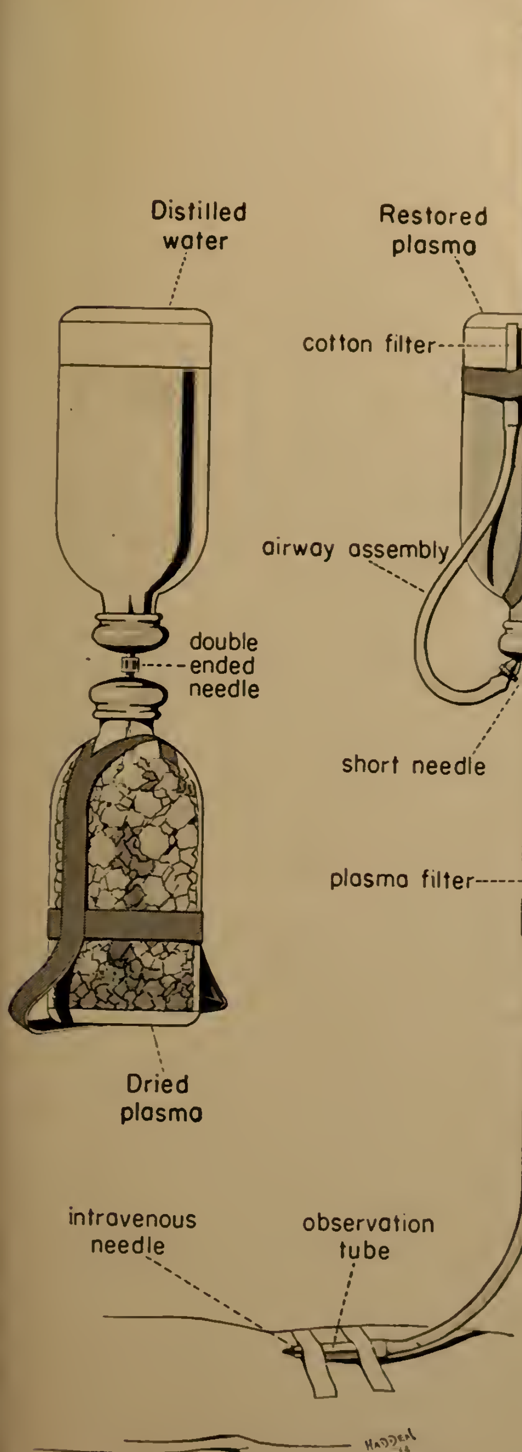


Figure 50.—Plasma Administration Assembly.

18. Insert needle in vein. If patient is to receive additional plasma, restore second bottle as outlined. Pull out needle from first bottle and insert in second bottle, while pinching intravenous tube to prevent it from filling with air. Elevate end of airway and fix it in place with the suspension tape.

NOTE.—Plasma should be used within 3 hours after restoration.

Fluids.—Many men in shock are dehydrated. Plasma and serum albumin tend to restore to normal the blood volume by drawing water from tissue spaces into the blood stream. Therefore, further tissue dehydration takes place. It is essential that fluids be given. Water is retained better if salt is added. Physiological saline solution is of great value either administered by mouth or intravenously. For oral use, salt tablets may be added to water in canteens. Fluids should be forced so that the patient will produce an output of 1,500 cc. of urine per day.

NOTE—Water may be retained better if sufficient salt is added to make physiological saline solution (0.85 percent). It must be remembered that salt water, if strong, may be used as an emetic. If the patient is nauseated salt water may increase the distress.

INFLAMMATION

Inflammation is the local reaction of the body to irritation. It is the reaction that takes place in tissue that is injured but not destroyed. The signs of inflammation are redness, swelling, heat, pain, and disturbance of function. Anyone who has smashed a finger can testify that it became red and swollen, hot and painful, and that as a finger it was useless. The same is true of a boil on the neck, a cinder in the eye, rheumatism in a knee, or an inflammation of the throat. The five signs given above are present.

These signs are due to the action of the blood vessels in the injured tissue. The blood vessels react to irritation by dilating. More blood comes into the area. The blood is warm and it is red; that accounts for two of the signs. As the blood vessels dilate, their walls begin to leak and blood serum escapes into the tissues. This accounts for the swelling and also for the pain because it is the pressure of the swelling on nerve endings that causes pain. The disturbance of function can

be due either to pain or to interference by the swelling.

Even as these changes in the little blood vessels are producing the cardinal symptoms of inflammation, the body is reacting to the injury. The white cells of the blood come into the area. Within the dilated blood vessels the white blood cells catch on the walls as the current brings them by. They press themselves through tiny chinks in the wall and escape into the tissues where the irritant is present. Thousands of them gather, and together they form a wall about the area and seal it off. Within this area the white cells work as scavengers (phagocytes), destroying bacteria and ingesting small particles of foreign matter or dead tissue.

As the sources of the injury are overcome or expelled, the tissues return again to normal. The white cells disperse. The blood vessels resume their usual size. The fluids flow away through the lymphatics. If tissue has been destroyed, it is replaced by scar tissue. The dilation of the blood vessels and the mobilization of the white cells against agents that injure the body are the two basic reactions in the process of inflammation.

Causes of Inflammation

Inflammation plays an important part in fractures, dislocations, sprains, strains, wounds, burns, frostbite, and many kinds of infection. A classification of the causes of inflammation follows:

Traumatic, such as blows and mechanical irritation.

Chemical, such as stings of insects, mustard gas, venom of serpents, poison ivy, acid, etc.

Thermal, heat and cold.

Microorganisms, such as staphylococcus, streptococcus, etc.

Other agents, such as electricity, X-rays, actinic rays of the sun, etc.

Treatment of Inflammation

The general principles involved in the treatment of inflammation are:

1. To remove the exciting cause.
2. To keep the inflamed part at rest.
3. To reduce the local blood pressure by elevation of the part.

Other agencies employed in the treatment of inflammation are heat and cold, wet dressings, and ointments. Heat acts by softening the tissues and hastening the carrying away of the products of inflammation, thus decreasing the pressure on the nerve ends in the inflamed area. Cold acts by contracting the dilated blood capillaries and thus decreasing tension. Wet dressings and ointments act by softening the tissues and frequently contain some agent to rid the inflamed area of the specific cause of inflammation—some microorganism, for instance.

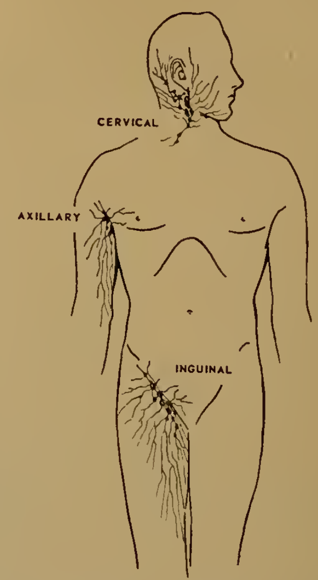


Figure 51.—Location of Principal Lymph Nodes.

Abscess Formation

An abscess is a localized area of infective inflammation containing live and dead microorganisms, live and dead phagocytes (white blood cells which have been combating the microorganisms), fluids forced out from the blood capillaries, and the broken-down products of dead tissue cells. The content of an abscess is called pus.

The treatment of an abscess is in accordance with the rules for treating other inflammations, but with the added rule that the pus when formed must be evacuated. Abscesses should be incised and drainage instituted in order to reduce the pressure on the tissues. The tissues must be ridded of the irritating products of infective inflammation, and the chances of the infecting organism gaining access to the general circulation and causing further trouble must be lessened.

Strict care must be taken not to introduce fur-

ther infective organisms when the incision is made; that is, an aseptic technique must be employed. The incision must large enough to allow good drainage.

Never squeeze an abscess as this tends to break down Nature's barrier and to spread the infection. The amount of tissue that may die is dependent upon the severity of the inflammation: this dead tissue is spoken of as slough. When the slough includes the skin or mucous membrane, an **ulcer** results.

A **boil,** or **furuncle,** is an abscess in the true skin in which the infecting microorganism generally gains access by way of a sebaceous or a sweat gland, and in which there is a small slough in or beneath the true skin. A boil at the end of the nose or within the nostrils is very dangerous because, as a result of handling, incision, or other trauma, the infection enters the blood and is very easily carried by the veins to the large venous channels on each side of the sphenoid bone (the cavernous sinuses) and thence spreads to the brain to form abscesses, or the meninges to cause meningitis, or into the general circulation to result in septicemia and possible death.

A **carbuncle** is a boil or furuncle in which there are multiple sloughs often coalescing in one beneath the true skin. When the pus from these sloughs finds its way to the surface an opening occurs, hence the numerous foci of pointing called "coming to a head." Carbuncles, wherever they are located, are very dangerous; those about the face are especially so on account of the ease with which infection can be carried to the cavernous sinuses and thence to other parts of the body as explained in the preceding paragraph. A patient suffering from one should be brought immediately under the care of a medical officer. If a furuncle breaks, one opening results; if a carbuncle breaks, numerous openings result. Diabetes, Bright's disease, and conditions of lowered resistance brought about by living in impure air, on improper foods, etc., render an individual particularly susceptible to boils.

Boils and carbuncles should be treated by:

1. Placing the site of the furuncle or carbuncle at rest.
2. Putting the patient to bed is advisable.
3. X-ray therapy is the ideal treatment when the boil or carbuncle is in the indurated state; that is, before it has come to a head.

If X-ray therapy is not available the treatment should be:

1. Rest and avoidance of trauma.
2. Application of heat by hot wet-dressings.
3. Relief of pain (aspirin or codeine may be given).
4. Ample fluid intake and high-caloric diet.
5. When there is definite fluctuation make a small incision to evacuate the pus. When there is a medical officer present and in the absence of X-ray facilities, early, radical, and complete excision is curative.

A boil or infected hair follicle at the end of the nose or inside the nostril is in one of the most dangerous areas for infections to develop. This area is known as the dangerous triangle. See illustration. A patient with an infection in this area should be brought under the care of a medical officer as soon as possible. If a medical officer is available within a few hours, leave the patient strictly alone.

1. Place at rest.
2. If several hours or more may elapse, the hospital corpsman may apply hot, wet saline compacts for fifteen minutes every two hours.
3. Administer 300,000 units of penicillin.
4. Place under the care of a medical officer as soon as possible.

Inflammation or infection in outlined area is particularly dangerous.

Figure 52.—The Dangerous Triangle.

WOUNDS

A **wound** is defined as the forcible solution of continuity of any of the tissues of the body. The principal types of wounds are clean or aseptic wounds, infected, or septic wounds, and poisoned wounds. A clean or aseptic wound is one to which no germs have gained access; the best example of it is a wound made by the surgeon's knife. An infected or septic wound is one in which there have been introduced pus-producing organisms or such organisms as produce tetanus or lockjaw, gas gangrene, or hydrophobia. A poisoned wound is one in which some nonliving poison, as distinguished from bacteria or microorganisms, has been introduced by the agent causing the wound; e. g., bites of insects, scorpions, snakes, etc.

Kinds of Wounds

An **incised wound** is one made by a sharp cutting instrument; this is the class of wounds commonly known as cuts.

A **lacerated wound** is the result of the tearing of the skin and underlying tissues by blunt instruments or machinery and presents ragged edges, which do not retract much and which, as a rule, consist of masses of torn tissues, frequently with dirt ground into them.

A **contused wound** is one in which the division of tissue is accompanied by more or less severe crushing.

A **punctured wound** is deep and narrow; e. g., stabs are punctured wounds.

Crushed wounds are more serious than they first appear, due to the fact that the dead tissues are an excellent culture medium for the growth of microorganisms of infective inflammation, resulting sometimes not only in loss of the part, but also in general infection of the body; that is, septicemia, or blood poisoning.

Gunshot wound is any wound inflicted by the missile of a weapon of warfare, such as rifles, pistols, cannon, etc.

When the skin and underlying tissues are divided, blood vessels, generally capillaries, also are divided, and there is more or less bleeding from the cut surfaces of the tissues with a clot forming between the cut surfaces. Young connective-tissue cells and capillary buds grow into this clot from the edges of the wound, replacing the blood elements. These young connective-tissue cells and the young capillaries form what is known as granulation tissue or "proud flesh." Later, the young connective-tissue cells and capillary buds develop into the mature connective tissue, and the epithelium of the skin grows over it from the edges of the wound. When the cut surfaces are so close together that there is very little granulation tissue required to heal the wound, healing is said to be by **first intention.**

When the wound is gaping and considerable granulation tissue is required, healing is said to be by **second intention.** Pus infection causes gaping of wounds; therefore in wounds infected with pus bacteria, healing is by second intention. Connective tissue filling in a gaping wound forms the so-called "scar."

Unless cut ends of tendons are brought together, the two ends will be so retracted and there will be so much connective tissue formed between them in the healing of the wound, that the function of the tendon will be lost. Unless the cut ends of a nerve trunk are brought together, the function of that nerve will be lost forever. Nerve fibrils making up a nerve trunk regenerate centrifugally; and if the pathway for this regeneration is blocked by a wall of connective tissue, these fibrils can never reach the part that they are supposed to innervate.

The local factors preventing and delaying the healing of wounds are:

1. Infection with pus bacteria.
2. The presence in the wound of foreign bodies, such as dirt or bits of clothing.
3. A lowered vitality of the edges of the wound due to crushing and tearing of the tissues.

General and constitutional factors also prevent and delay healing; among these factors are poor circulation of blood, diabetes, nephritis, and syphilis.

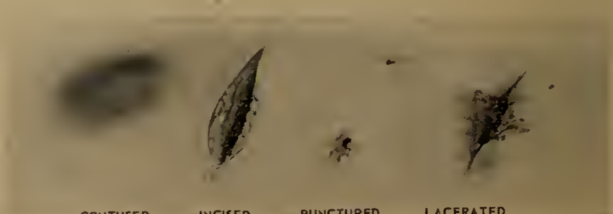


Figure 53.—Kinds of Wounds.

Treatment of Wounds

1. Stop hemorrhage and treat shock.
2. Handle the wound so as not to introduce fresh bacteria of infection.
3. Remove foreign bodies, such as dirt, bits of clothing, etc., from the wound.
4. If infective bacteria already have been introduced into the wound, take measure to eliminate them or prevent their development.
5. If the wound is an aseptic one, bring the edges together so that it can heal by first intention; if the wound is an infected one, keep the wound open and furnish drainage: if the wound is a poisoned one, neutralize the poison in it and prevent its entrance into the general circulation.
6. Treat any constitutional condition which may delay or prevent healing.

Bacteria Causing Infection

There are two types of bacteria commonly causing infection in wounds—**aerobic** and **anaerobic.** The former are bacteria that live and multiply in the presence of air, while the latter are bacteria that live and multiply in the absence of air. The principal bacteria which cause infective inflammation and septicemia or blood poisoning are *streptococci*, some varieties of which are hemolytic (destroy red blood cells), *staphylococci Pseudomonas aeruginosa* (*Bacillus pyocyaneus*), frequently called the bacillus of green or blue pus; these are aerobic. There are several anaerobic bacteria which are frequently present in wounds. They commonly inhabit the intestinal tracts of man and other animals and are often found in soils which have been fertilized with animal manure. Among those occurring in wounds, especially in war wounds, are the *Clostridium welchii*, commonly termed the gas bacillus and causing gas gangrene, the *Clostridium sporogenes*, the *Clostridium oedematiens*, and the *Clostridium histolyticum*. The *Clostridium tetani*, or tetanus bacillus, is common in the feces of horses and cattle, consequently it is found with great frequency in soils fertilized with manure from those animals. It is often associated with *Clostridium welchii* in wounds and it produces a toxin which is one of the most powerful poisons known, being said to be 20 times as poisonous as dried cobra venom. The filtrable virus causing rabies, often termed hydrophobia (fear of water which is a common symptom of the disease), is perhaps anaerobic in character.

Inasmuch as the bacteria of pus infection are present everywhere, any wound is likely to be infected with them. However, contused and lacerated wounds are most likely to suffer from infective inflammation, owing to the lowered vitality of the tissues. The bacteria of tetanus or lockjaw and of gas gangrene are found in exceptional numbers in the intestinal contents of herbivorous animals, such as horses and cattle, and, for that reason, wounds. inflicted by objects which have been contaminated by manure or by heavily fertilized soil are most liable to have introduced into them the bacteria of these diseases.

In badly lacerated wounds and in punctured wounds there is great likelihood of absence of air due to the flapping back of the torn tissues after infliction of the wound, and for this reason these types of wounds afford a very favorite environment for the development of tetanus or gas gangrene. Tetanus, or lockjaw, frequently occurs after stepping on a nail near a barn or stable, the nail previously having become infected with *Clostridium tetani* from the excretions of horses or cattle. The virus rabies is found in the saliva of a rabid animal and is introduced by its bite. These bites are either lacerated or punctured wounds, with their associated anaerobic conditions.

Types of Dressings

A **wound dressing** consists of everything used to cover or dress a wound. The pad which is put directly over the wound is called a compress. In ordinary emergency treatment a wound dressing consists of a compress with bandage to hold it on. A dressing may be either dry or wet, aseptic or antiseptic.

An **aseptic dressing** is one which is sterile: that is, one with no bacteria in it.

An **antiseptic dressing** is one which, in addition to being sterile, contains some substance for killing bacteria.

A **wet dressing** generally is an antiseptic dressing. A wet antiseptic dressing generally is used in wounds where infective inflammation is going on.

A **dry sterile dressing** is used to cover a recent

wound which is considered to be free from infection. The purpose of a wound dressing is to stop hemorrhage, to prevent introduction of bacteria, and to prevent further injury to the wound.

The Navy supplies a first-aid packet which is a hermetically sealed tin can containing a dry sterile dressing. This is excellent for a small wound. The directions for its use are contained in the packet. For large wounds, sick bays aboard ship are furnished with large and small shell-wound dressings. All these dressings consist of a sterile gauze compress with bandage attached. Any piece of cloth, such as gauze, cotton, linen, muslin, or a handkerchief, is suitable for a compress in case of emergency, provided it is rendered sterile; and anything that can be used for bandaging is suitable as a bandage. The most vital point about material used as the compress of a wound dressing is that, before it is applied to a wound, it should be rendered sterile.

The part of the dressing which is to come in contact with the wound must be kept absolutely sterile; i. e., it must not be touched with any part of the body or anything else except sterile instruments before its application to the wound. In an emergency, material to be used in a wound dressing may be sterilized by boiling it 10 minutes.

First-aid Treatment of Wounds

1. Stop the hemorrhage.
2. Treat the shock.
3. Apply a sterile dressing to the wound.
4. If a surgeon is not available, the wound must be further treated as prescribed hereafter.

In Treating a Fresh Wound

1. Cleanse your hands as thoroughly as possible by a thorough scrubbing with soap and hot water.
2. Dip your hands in 70-percent alcohol.
3. Sterilize all instruments to be used in removing foreign bodies, such as dirt, glass, splinters, etc., or for shaving the skin about the wound.
4. If there is much bleeding, arrest the hemorrhage.
5. If there is much hair about the part, remove it by cutting or shaving for a distance of several inches from the cut edges.
6. If there is much grease in and about the wound, remove it with turpentine or gasoline. Remove all foreign particles with sterile forceps.
7. Clean the skin about the wound with a sterile, damp cloth; while doing this, protect the wound with a piece of sterile gauze.
8. Dry the wound and skin about it with sterile dry cloth or cotton.
9. Apply tincture of merthiolate to all parts of the wound and to the skin about the wound for a distance of about one-half inch beyond the wound edges.
10. After the skin has been well dried, the wound edges are brought together and a dry dressing is applied.

Attempts to bring the wound edges together should not be made when the patient can be brought under the care of a surgeon in the very near future; but if hours or days must elapse before the service of a medical officer can be obtained, coaptation should be done in cases requiring it. The edges of a wound should not be brought together before foreign bodies and dirt have been removed and wound edges have been cleaned. Wounds in which infective inflammation is going on should be left open and allowed to drain. The two methods by which coaptation may be accomplished are by means of sutures and by means of adhesive strings. The former is preferable, as by the latter method bacteria of infective inflammation most probably will be introduced.

As a rule, the edges of large, deep wounds should not be too tightly apposed. Some chance of escape should be left for the serum and blood which are sure to be present; that is, means of drainage should be supplied. This may be done by the use of small pieces of sterile rubber tubing, strands of catgut or silkworm gut, or a narrow strip of gauze which has been sterilized by boiling. These drains should be placed in the lower angle of the wound. Wounds which are dirty and look bad should be left open.

The materials ordinarily used for sutures are plain catgut, chromicized catgut, kangaroo tendon, silkworm gut, silk, or linen; sometimes horsehair is used. Suture material, also called ligatures, is divided into absorbable and nonabsorbable ligatures. Absorbable ligatures are those which can be left in a wound, inasmuch as the tissues absorb them; included in this class are catgut and kangaroo tendon. Silkworm gut, silk, linen, and horsehair are nonabsorbable ligatures and must be removed after 6 or 7 days.

Chromicized catgut is catgut which has been so treated that it will not be so quickly absorbed as plain catgut. Catgut is the ligature to be preferred in the suturing of wounds. Needles used in the suturing of wounds are curved, straight, round, or cutting ones.

Where the skin must be pierced, the curved cutting needle is preferable. The main point about all suture material to be used in a wound is that it must be sterile. In case of emergency, an ordinary sewing needle with cotton or silk thread, well sterilized by boiling, may be used. This suture is nonabsorbable and must be removed after 6 or 7 days. With the operator's hands and also the wound well cleansed, the needle, threaded with the suture, is passed through the skin about one-eighth of an inch from the cut edge and on past the opposite side at a corresponding point. The suture then is tied and the ends cut, leaving about one-quarter of an inch remaining; care should be taken in tying the suture to use but little tension, sufficient only to bring the cut edges in accurate approximation. The remaining stitches are inserted in the same manner at a distance of one-quarter to one-half of an inch apart until the wound is closed. When a tendon or large nerve has been cut, the ends must be brought together and sutured with catgut before the wound is closed. Suturing of tendons and nerves should be done by medical officers.

Treatment of an Infected Wound

1. Elevate the part.
2. Put it at rest.
3. Remove foreign bodies, if present.
4. Remove enough sutures, if present, to obtain good drainage.
5. Insert drain.
6. Apply a wet antiseptic dressing.
7. Treat the constitutional symptoms.

One of the measures taken in a fresh wound suspected of being infected with tetanus or gas gangrene is to clean and treat the wound and keep it freely open for a time in order that anaerobic conditions may not exist for growth of these bacteria. As a further precautionary measure, tetanus antitoxin is given. A punctured wound suspected of being infected is frequently cauterized and a dry dressing applied.

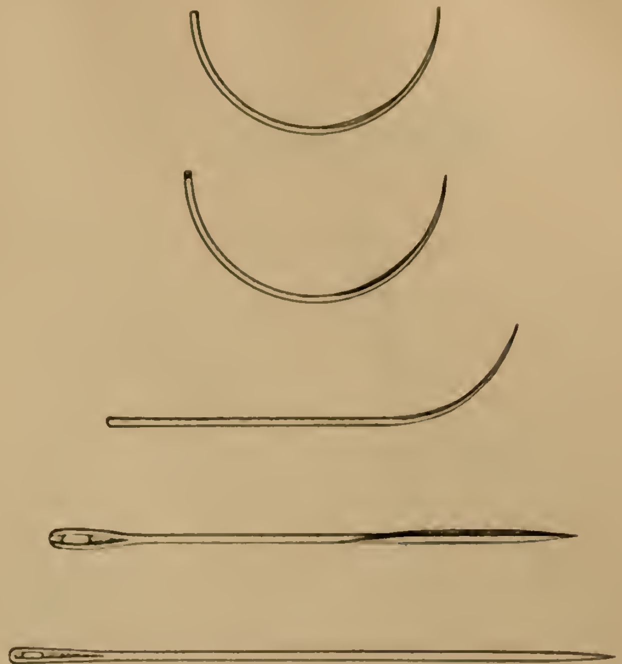


Figure 54.—Some Types of Needles Used in Suturing.

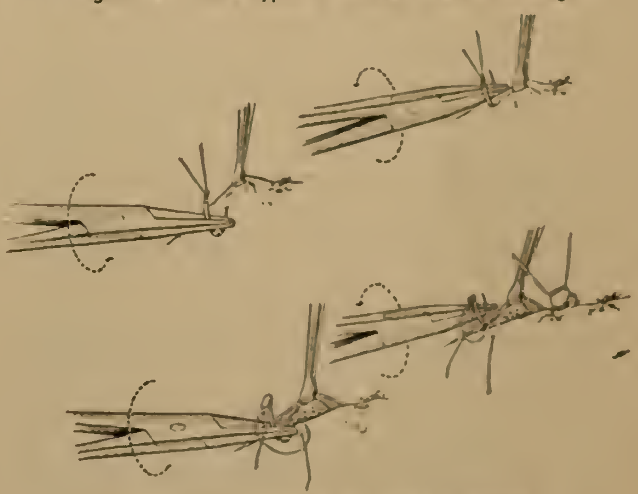


Figure 55.—Technique of Closing a Wound.

CHEST WOUNDS

Because of the peculiar physiology of the respiratory mechanism, wounds of the chest are extremely important. From the chapter on anatomy and physiology, it is learned that the lungs are covered with a membrane called visceral pleura; this also extends over and covers the inner side of the chest wall, and thus it forms a cavity between the lung and chest wall called the pleural cavity. The pleura is a smooth, moist, glistening membrane which allows the lung to expand and move freely over the inner surface of the chest wall.

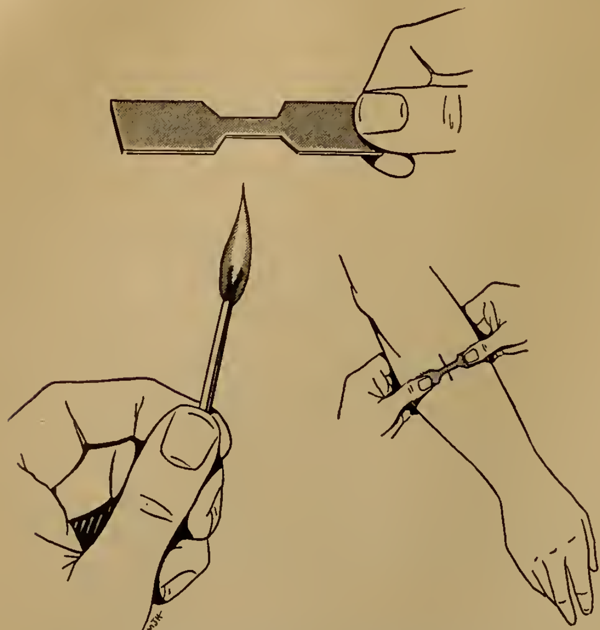


Figure 56.—Butter-Fly Adhesive Strap.

The lungs are an elastic substance. The inside of the chest is a closed cavity; by means of contraction of the diaphragm and the intercostal muscles, the inside of the chest cavity is increased, causing a negative pressure or suction of the chest. Being an elastic, expansible substance, the lungs allow air to come down the trachea (windpipe) into the bronchi and fill the lungs; this is called inspiration.

In wounds of the chest a hole is made in the chest wall. This may penetrate just the parietal pleura or it may enter the lung substance. Penetration of the chest wall or the pleura will cause a pneumothorax (air in the pleural space). A hole in the chest wall allows air to enter the pleural space and, therefore, no negative pressure can be built up; as a result the lung collapses. This is treated by making the dressing and bandage over the chest wound airtight. The air that seeped into the pleural cavity is slowly absorbed and intrapleural negative pressure is again restored and the lung slowly re-expands. When the lung is penetrated the air escapes from the alveoli (air sacs) and causes a pneumothorax. Because of the elasticity of the lung the hole closes on expiration and no air escapes if the chest wall is intact. This causes what is known as a tension pneumothorax which is very difficult to treat without medical attention; consequently a medical officer should be summoned at once. In instances where blood vessels are ruptured blood may collect in the pleural cavity; this is known as hemathorax. Where the rupture of a vessel occurs in the lung, the patient may cough up blood; this is known as hemoptysis.

Treatment of Chest Wounds

The treatment of chest wounds is as follows:

1. **Decrease respiratory embarrassment;** make the wound of the chest airtight and administer oxygen if available.

2. **Prevent infection, give penicillin** when it is available, and clean the wound and apply a sterile dressing.

3. **Alleviate pain.**—Give morphine where there is no evidence of head injury.

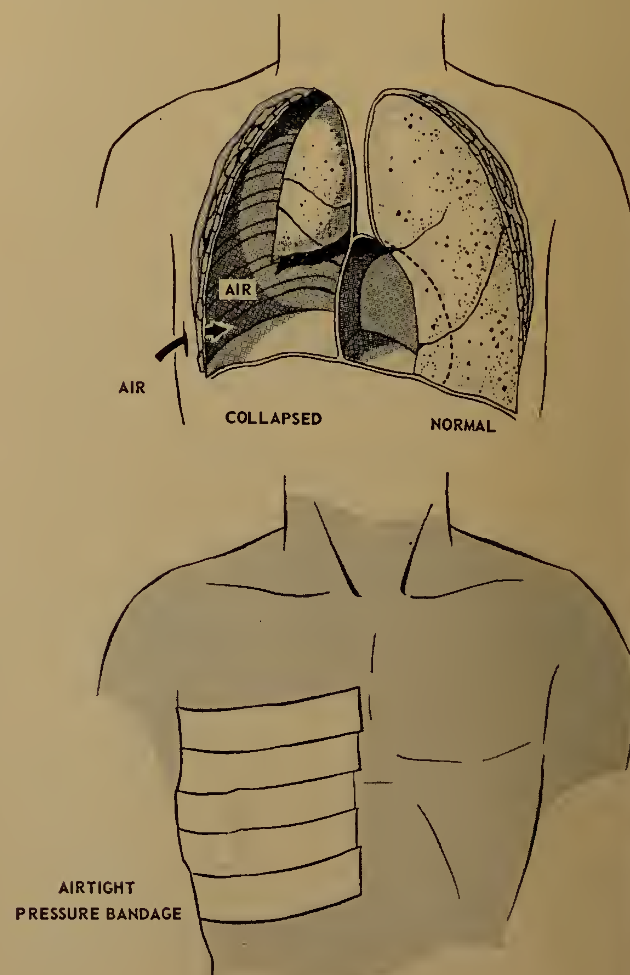


Figure 57.—Collapsed Lung Following Chest Wound and Application of Airtight Pressure Dressing.

4. In the presence of hemoptysis **prevent** the patient from coughing, as this may dislodge the blood clot that forms. Administration of morphine will help to prevent coughing. Swallowing cracked ice also helps.

5. **Treat shock** if present.

Abdominal Wounds

Wounds and injuries of the abdomen are important because of the intra-abdominal organs. Simple wounds of the abdomen are relatively unimportant and are treated as ordinary wounds. Wounds of the abdomen do, however, become of serious importance when they penetrate the abdomen into the peritoneal cavity. Pathogenic organisms gain entrance into the peritoneal cavity and set up peritonitis. They are also important from the standpoint that if the wound is extensive enough, the contents of the abdomen will protrude; this is known as evisceration.

More important, however, is the rupture of the bowel, which allows the intestinal contents to spill out into the peritoneal cavity and cause both a chemical peritonitis due to the digestive juices and a bacterial peritonitis due to the colon bacillus that normally inhabit the lower part of the gastrointestinal tract. The diagnosis of perforation of the bowel is not difficult to make if the patient is wounded by a flying missile or stabbed with a sharp object; however, it becomes much more of a difficult problem when the patient is struck a blow in the abdomen without actually causing a wound in the abdominal wall. The bowel may either be lacerated by compression against the anterior spine or by compression of air in the bowel which causes the bowel to burst.

Figure 58.—Abdominal Wound with Protrusion of Intestine.

Symptoms and Signs

1. **Pain** is the first thing the patient usually complains of. The pain is usually an excruciating type of pain that is generalized over the abdomen.

2. **Nausea and vomiting** usually accompany the pain; however, they may follow it. The nausea and vomiting are due to reverse peristalsis set up by irritation of the bowel due to trauma.

3. **Tenderness** is always present. The tenderness can be elicited by placing the flat hand on the abdomen and causing firm but gentle pressure. Rebound tenderness can be elicited by suddenly releasing the firm pressure on the abdomen. This is usually due to a peritonitis being present.

4. **Abdominal rigidity** is due to spasm of the abdominal muscles which is Nature's way of splinting the abdomen in order not to cause further pain. One may also see that the patient will draw up his knees in order to relieve the spastic muscles.

5. **Shock** will be present if the pain is intolerable, and if there is a great loss of blood either extra- or intraperitoneally. Severe, overwhelming infection may also cause shock. The pulse will be rapid and weak. The blood pressure will be low.

Treatment of Abdominal Wounds

It is imperative that abdominal, chest, and head injuries get first priority in transportation to a hospital where they may receive surgical intervention of their injuries. These types of injuries should not be given any more treatment than the essential first aid that is necessary. It is also imperative that these patients be taken to the hospital at once if they are expected to be given a fair chance of survival. First aid of abdominal injuries is to:

1. **Relieve the pain** unless a medical officer will be available in a short time. Giving opiates may make a diagnosis rather difficult for the physician and the patient may be treated erroneously. If

the patient is to be transported, then one-fourth grain of morphine will support the patient for a few hours.

2. **Treat the wound.**—If it is a simple wound, treat it as described above. If an evisceration exists, the bowel should be covered with a normal saline soaked sterile gauze dressing and a scultetus binder applied. Do not attempt to manipulate or replace the bowel in any manner. This should be left up to the surgeon. To expedite transportation is the most important thing you can do. (See fig. 58.)

3. **Prevent** further infection by giving penicillin and streptomycin if available. Avoid giving anything by mouth because this will cause more intestinal juices to spill out into the peritoneal cavity, thus causing more pain and damage. The purpose for this is to splint the bowel as much as possible so that it may be put at rest. Gas bacillus and tetanus antitoxin should always be given.

4. **Treat the shock** if present.

5. For a simple method of holding dressing in place see Montgomery dressing under nursing procedures.

Burns

There are numerous causes of burns but generally they may be divided into two groups: **Thermal** and **chemical.** Thermal burns are those due to heat produced by fire, hot liquids, steam, explosion and combustion of gases, overexposure to the sun, and electrical burns. Chemical burns are those due to the reaction of strong chemicals (acids and alkalies) to the skin.

Burns are classified according to the degree of depth of the burn.

1. **First-degree burns.**—Those in which there is only an erythema or redness of the skin.

2. **Second-degree burns.**—Those in which blisters form. However, none of the secondary skin structure, hair, sweat glands, or oil glands are destroyed permanently.

3. **Third-degree burns.**—Those in which the skin is burned black and all secondary skin structures are permanently destroyed.

Treatment of Burns

The main principles involved in the emergency first-aid treatment of burns are:

1. Relieve the pain.
2. Prevent shock from existing.
3. Prevent infection of the burn.
4. Make the patient as comfortable as possible.

As soon as the extent of the burn and other injuries are determined, the patient should be given some medication to relieve the pain. In mild cases, ½ to 1 grain of codeine given orally will suffice; however, if the burns are severe the patient should be given morphine hypodermically. As much as ¼ to ½ grain can be given without due concern. It must be remembered, that in the first aid treatment of burns, other conditions may exist which may need attention also, such as fractures and head injuries. If a head injury does exist, do not give opiates.

The next most important thing to do is to treat the shock. This has already been done to some extent by relieving the pain. It has been observed, however, during the past 20 years, that patients who experience severe burns lose great amounts of protein due to a secretion of the patient's serum through the burned areas. This hypoproteinemia can be somewhat controlled by the administration of plasma or more preferably whole blood if it is available. Usually in an emergency, whole blood is not available while plasma is, in most instances, present in a first-aid kit.

It should be remembered, however, that usually the burned areas are already sterile from the heat that caused the burn; therefore the less the person administering first aid interferes with the burned area, the better chance the patient has of not becoming infected.

If the services of a medical officer cannot be obtained in a short period of time, then the corpsman should proceed to dress the burned areas. This is done in the following manner:

1. Without attempting to break the skin and using sterile technique, remove all clothing and charred materials from the burned area. If blisters are present, do not break them.

2. Apply very thin pieces of sterile vaseline gauze directly over the burned area.

3. Apply cotton wadding, gauze fluffs, or sterile mechanics waste next to the vaseline gauze so as to make the dressing bulky.

4. Following this, apply elastic bandages snugly to make a "pressure" dressing.

If penicillin is obtainable, the patient should be

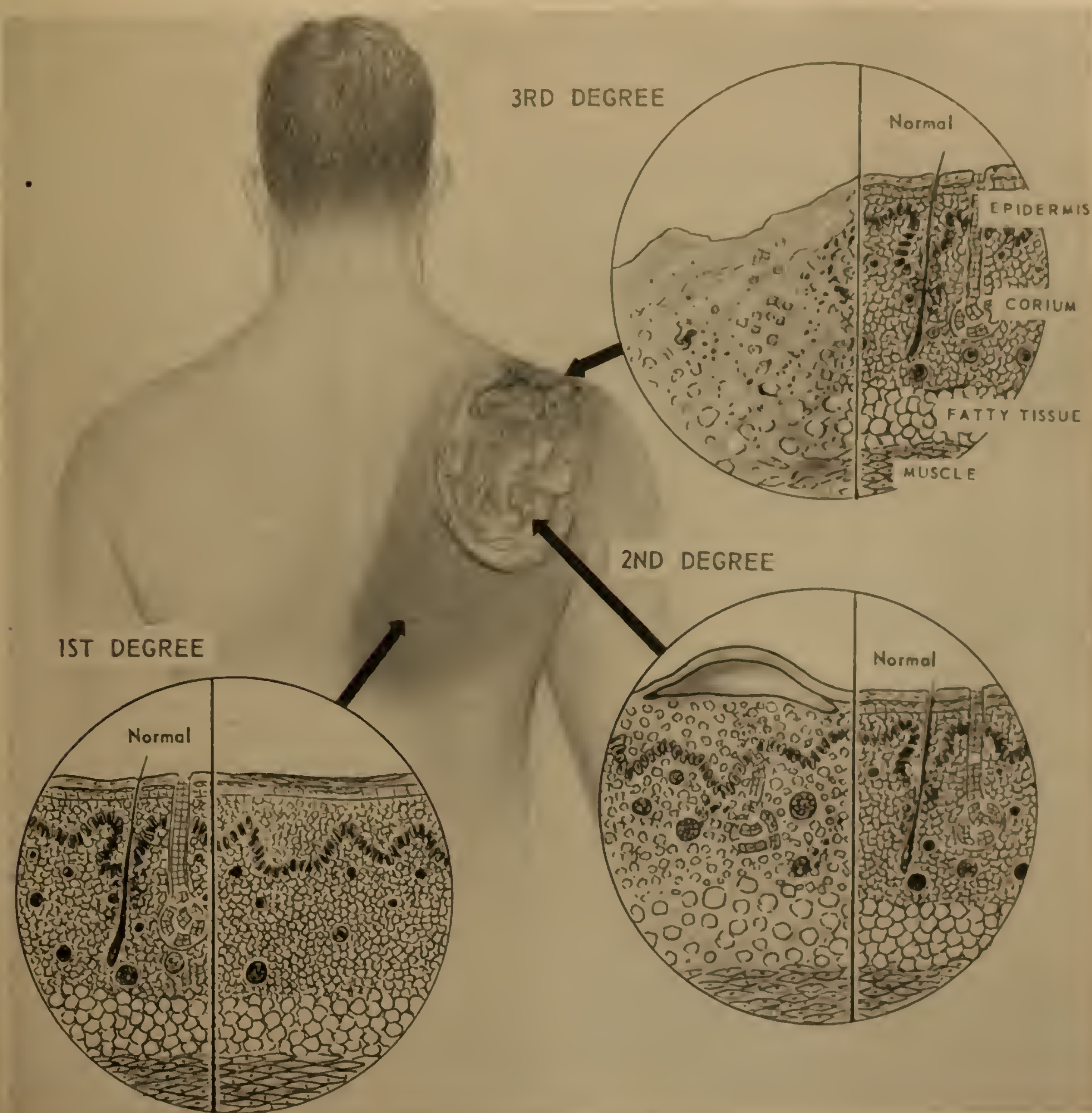


Figure 59.—Types and Degrees of Burns.

immediately given 300,000 units of procaine penicillin intramuscularly as a prophylactic measure against infection. No further definitive steps should be undertaken by the corpsman in the treatment of burns. Having completed all the above and having made sure that no medical officer is available, the corpsman should make the necessary arrangements to have the patient transferred to a hospital at once.

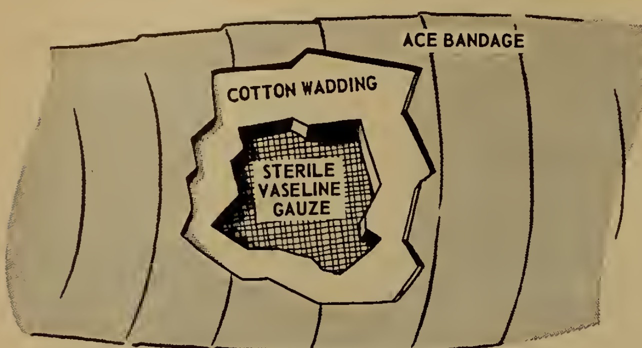


Figure 60.—Pressure Dressing for Burns.

Poisonous Snakes

Poisonous snakes are classified into viperine snakes and colubrine snakes. To the viperine family belong the rattlesnake, the copperhead, the water moccasin, and the viper; to the colubrine family belong the cobra and the coral snake.

In **poisonous** snakes the teeth are arranged in two rows, with a fang on each side; the fangs are outside the teeth and near the point of the jaw.

Nonpoisonous snakes have four rows of teeth without fangs. The imprint of the wound often will tell whether a person has been bitten by a poisonous or a nonpoisonous snake. The venom of different poisonous snakes differs in its action. The poisonous constituents are neurotoxin, a nerve poison, and hemorrhagin, which injures the lining of the blood vessels so that there is an escape of blood into the surrounding tissues; a third constituent is hemolysin, which destroys red blood cells.

The venom of colubrine snakes is made up principally of neurotoxin and that of viperine snakes is made up of hemorrhagin. In colubrine poisoning, the local symptoms are not marked, though there are at times severe pain and some tenderness, swelling, and discoloration at the site of the bite. In 1½ to 2½ hours the patient begins to feel tired and drowsy, there often begins some nausea and vomiting, and paralysis sets in, generally affecting the extremities first and then becoming more generalized. This paralysis finally affects respiration, so that the patient's breathing becomes slow and shallow and finally ceases. Convulsions also may be present.

In viperine poisoning there is pain at the seat of the bite, which soon becomes excruciating, with rapid swelling and discoloration; there is at the same time a feeling of nausea, faintness, and a sense of depression; the pulse becomes rapid and feeble and the breathing is labored.

In fatal cases, death may occur in 24 to 48 hours. The severity of the symptoms and final outcome depend upon the amount of venom injected and absorbed into the general circulation, which, in a large measure, depends on the size of the snake.

Treatment of Snake Bites

Prompt action is imperative because removal of the venom is more difficult, or even impossible, after it is absorbed. Make the patient lie down and keep quiet. Muscular effort only spreads the poison. Tie a constricting band firmly around the limb just above the bite in order to restrict the spread of the poison and make the veins stand out on the surface. This band may be a handkerchief, necktie, shoestring, or bandage. It should be tight enough to prevent the return flow of blood and lymph in the surface vessels, but not tight enough to affect the deeper arteries and veins.

A twist is not necessary because this is not a tourniquet. Too much deep pressure is dangerous; it tends to increase the sloughing caused by the venom. If swelling causes too much constriction, the band must be loosened a little; and as the swelling progresses beyond the band, it should be moved up the limb whenever necessary.

1. **Apply** the constricting band.
2. **Sterilize** a sharp knife or razor blade with a match flame, iodine, or alcohol.
3. **Make a cross-cut incision** through each fang mark. These cuts should be about one-fourth inch long; when the marks are close together, two cross cuts will serve to connect them. Be careful to avoid large veins and arteries near the surface and other delicate structures, such as nerves and tendons.

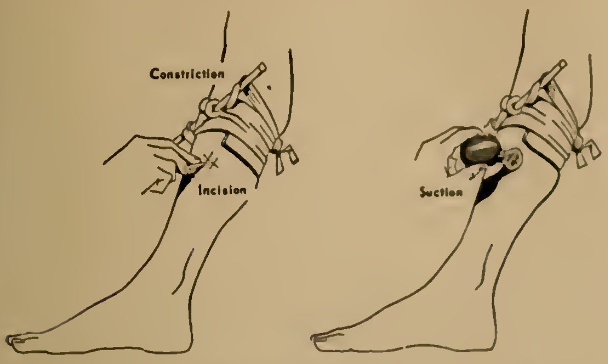


Figure 61.—Proper Method of Treatment for Snake Bite.

The cuts must be made down through the skin so that the poison can be sucked out. Since the skin is variable in thickness, the cut may have to be one-fourth inch or more deep to get into the soft tissues beneath the surface where the poison has been injected. In the wrist and in other places where many important structures lie near the surface, be careful to cut only through the skin so that you avoid cutting tendons and blood vessels.

4. **Apply suction immediately** and keep it up until the physician arrives. You can apply it with any of the various suction cups or syringes found in the snake-bite kits. Those which create and maintain suction by a spring plunger or rubber bulb are more effective than the hand-operated syringe because several of them can be used at close intervals when necessary. Suction by mouth is also possible but the lip and cheek muscles soon tire; therefore mechanical suction devices are better because suction may have to be continued for several hours. But mouth suction will be needed until a mechanical device can be obtained. If no such device is available, take a bottle or a small-mouthed jar and heat it in hot water or burn paper or cotton inside it; then apply the mouth of the bottle immediately over the cross-cut. Suction is created as the bottle cools.

Without adequate treatment, about 15 percent of the people with snake bite die. Children, who are more likely to be bitten than adults, need medical attention as promptly as possible because the danger is increased by the relative size of the victim and the dose.

As the poison spreads through the surrounding tissues, the swelling also increases. When the swelling has spread about 3 inches above the bite, an additional ring of cross-cut incisions about 2 inches from the bite and 2 inches from each other can be made toward the body. Other successive cuts should be made as the swelling progresses. The constricting band is moved up the limb to keep ahead of the swelling.

Apply suction to each of these cuts for 15 minutes in every hour (as long as the available suction cups will permit), and keep the cuts covered with wet, hot compresses of strong Epsom salt solution or table salt solution between the periods of suction. As these cuts are made in the swollen area, a rather clear fluid, slightly blood-tinged, will be obtained on suction. Not much blood is intended to be withdrawn. If a blood vessel is cut, control the bleeding by applying pressure with a small compress held by the fingers; do not apply suction to that incision. As many as 30 or 40 cuts may be necessary in a severe case. Keep the limb slightly lower than the rest of the body for best results.

There are **antivenom** serums available for the treatment of poisoning by snake bite, one which neutralizes neurotoxin and another which neutralizes hemorrhagin. They are injected hypodermically or intravenously and are very effective if properly used; that is, serum to combat the venom of a colubrine snake must be used against that type of snake bite, and the specific serum for

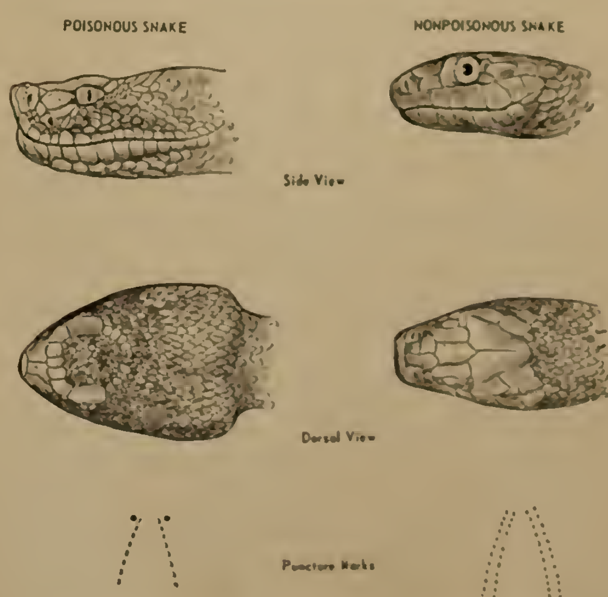


Figure 62.—Comparison of Poisonous and Nonpoisonous Snakes.

the viperine snake venom must be used to combat the toxin of that type of snake in order to get results.

INJURY OF MUSCLES, JOINTS, AND BONES

A **contusion**, or a bruise as it is commonly termed, is a crushing and tearing of the tissues, usually without a break in the skin. It is characterized by swelling, tenderness, and discoloration due to the rupture of blood vessels in the neighborhood of the injury. At first the discoloration is red, then blue or black, and finally is yellow or green; when the discoloration is yellow or green it is commonly called back and blue spots. The change in color is due to the chemical change in the coloring matter of the blood hemoglobin. The rapidity in the formation of the swelling and its size depend on the number and size of the blood vessels ruptured. Contusions vary in extent from an ordinary black and blue spot to the almost complete pulpefaction of a limb with laceration of blood vessels and nerves, such as sometimes occur in railway or other accidents. A black eye is an example of a contusion.

Slight contusions as a rule require no treatment. With severe contusions there is more or less shock which must be treated. For the contusion itself, the treatment is to stop the subcutaneous hemorrhage. This can be done by rest and elevation of the part and by very hot or cold applications; if the injury is in a limb, firm, even pressure of a bandage may be effective. Later, when the bleeding has ceased, the absorption of the extravasated blood may be hastened by hot fomentations and massage. In the case of severe contusions and in contusions in elderly people, hot water is much better than cold, as the latter tends to lower the vitality of injured tissue.

A **strain** is the overstretching of a muscle or tendon with an attendant rupture of the muscle or tendon fibers. In severe strains, small blood vessels are often ruptured, resulting in the escape of blood into the muscles in the same way that blood escapes beneath the skin in the case of a bruise. It is generally the result of violent exertion or sudden unexpected movement. The symptoms are pain in the affected muscle, stiffness, lameness, and more or less swelling. If complete rupture occurs, there will be loss of power of the affected muscle, and on examination there will be found a distinct gap with considerable swelling above it due to retraction of the muscle fibers.

For slight strain, the treatment consists of:

1. Strapping with adhesive plaster or bandaging, which, with rest, gives the most comfort.
2. After 2 or 3 days, graduated massage may be given.
3. If rupture occurs and if surgical assistance is lacking, immobilize the part by splints or bandages and place the part in such a position that the muscles are relaxed, thus allowing the torn fibers to come together.

A **sprain** is an injury to a joint due to wrenching or twisting its ligaments and adjacent soft parts. There usually are momentary dislocation and automatic reduction of the joint affected. There also may be injury to cartilages, and even portions of bone to which the ligaments are attached may be torn away. Accompanying these injuries there is more or less escape of blood into the joint itself and surrounding tissues, resulting in severe pain and marked swelling of the injured part. Later, discoloration develops at the site of injury. Sprains of the ankle and wrist are the most common. Frequently it is difficult to determine whether or not a sprain is complicated with fracture. An X-ray examination is always advisable to determine the presence of a fracture in these cases.

Treatment of Sprains

In the treatment of sprains all severe cases should be brought under the care of a medical officer, particularly as the condition may be complicated with fracture.

1. Elevate the joint and apply very hot or very cold water for one-half an hour to an hour to stop the subcutaneous hemorrhage.
2. Then apply a tight bandage and keep the joint at rest in order to give the torn ligaments and tissues a chance to heal and the effused blood to be absorbed.
3. Treatment of a sprain of the ankle by immediately strapping the joint and by allowing the patient to walk about may be practiced in the less severe, uncomplicated cases. For this purpose strips of adhesive plaster 1 to 1½ inches wide and about 18 inches long should be obtained. A strip is started well behind at the junction of

the lower and middle third of the leg of the injured side and is carried down under the heel with considerable tension, across the sole, and up the other side of the joint. The middle of another strip is applied to the point of the heel and the two ends are carried forward over the foot, but not far enough to meet. Leg strips and foot strips alternate, interlacing with each other and overlapping about one-third of the previous strip each time until the ankle joint is covered. Strapping in this manner furnishes pressure and at the same time fixes the joint and gives support to the torn ligaments. If any individual is unable to walk immediately after injury to the ankle, the injury should be considered as a fracture until proven otherwise.

Figure 63.—Method of Strapping Ankle.

Dislocation

A dislocation is a slipping away from each other of the bones which form a joint, resulting usually in a locking of the bones in a new position. Necessarily the dislocation is attended with tearing of the ligaments and often with rupture of the muscular attachments as well, except in a joint which, on account of frequent prior dislocations, has had its ligaments so stretched that not only is dislocation easy but no tearing of the ligaments results. As a result of the tearing of structure about the joint, there is also rupturing of the blood vessels, with consequent swelling and discoloration.

Dislocations must be differentiated from fractures and sprains. In all three conditions there may be swelling and pain in the neighborhood of a joint. In fracture there is an unnatural movement of the bone between the joints instead of immobility at the joints as in dislocations, and the movement is attended with a grating sound and sensation. The deformity is in the bone between the joints in fractures, whereas the deformity is at the joint in dislocations. In dislocations there is immobility at the joint and between the joints, and the head of the dislocated bone may be felt in an abnormal position. In sprains there is absence of any of the symptoms of dislocation except swelling and pain. As a rule sprains are momentary dislocations in which the head of the bone has slipped back into place. If facilities are available, all cases should be X-rayed before and after treatment.

Treatment of Dislocations

The treatment consists in restoring the bones to their normal position (spoken of as "reducing the dislocation") and then in so confining the parts that a recurrence of the trouble will be improbable. The joint should be immobilized until the rents in the ligament have healed. While some dislocations slip easily back into place, proper reduction of the majority requires considerable knowledge, skill, and either local or general anesthesia. Without careful manipulation, blood vessels and nerves not only may be injured but a simple dislocation may become complicated with fracture. In view of this, if surgical aid can be obtained within a day or two, do not attempt to reduce a dislocation, except perhaps in case of the jaw and finger.

1. Loosen the clothing about the injured part and support it as comfortably as possible in the new position, or if the patient must be moved, support the limb in a sling or by splints and bandages and summon surgical assistance.

2. If, however, surgical assistance cannot be had for some time, perhaps for 3 or 4 days, careful attempts should be made to reduce the dislocation, as the head of the bones concerned most probably will become bound by connective tissue formation and then reduction will become next to impossible without an operation. Shock is often present with major dislocations and should be treated.

Dislocation of the Jaw

In this condition the patient cannot speak or close his jaws. The dislocation is due generally to a blow upon the mouth when open or by yawning

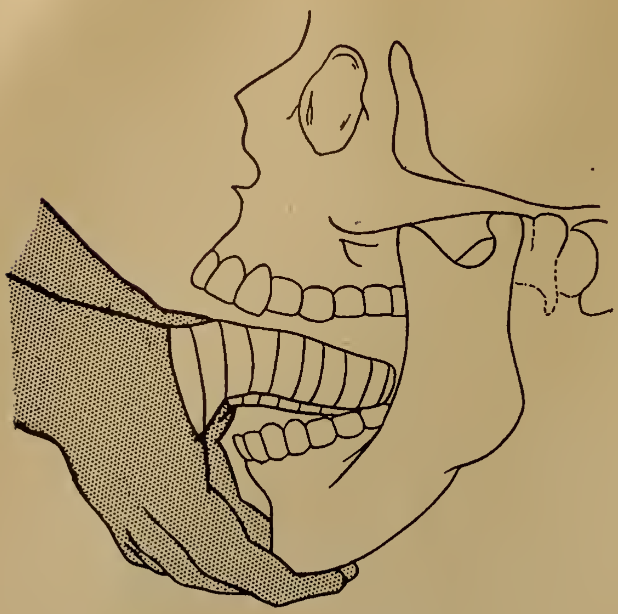


Figure 64.—Reduction of Dislocated Jaw.

or laughing. This dislocation usually is reduced without much difficulty, but there is great danger of the thumbs of the operator being bitten.

Treatment

Wrap the thumbs well with a handkerchief or bandage, stand in front of the patient, and while pressing with the thumbs in the mouth just back of the last lower molars, lift up the chin with the fingers. The jaw usually will snap at once into place, and the thumbs must be quickly withdrawn to prevent them from being bitten. After reduction no further treatment is indicated, but the patient should be advised to open the mouth no oftener than necessary.

Dislocation of the Finger

The finger joints are the most important joints of the upper limb. These joints are particularly susceptible to injury and very readily stiffen following even minor injuries, so that improper treatment may result in months of incapacity. Every finger injury must be treated with the greatest of respect.

Treatment

With a dislocated finger joint, pull on the dislocated end, at the same time bending it backward if the dislocation is forward, or forward if the

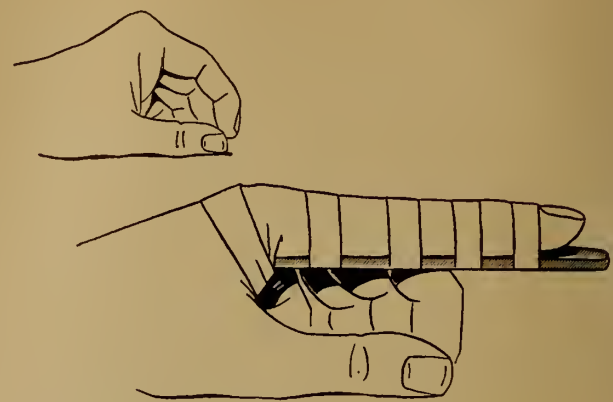


Figure 65.—Treatment of Dislocation of the Finger.

dislocation is backward, and pushing the joint into place; strap or splint the finger.

Dislocation of the Shoulder

In this dislocation the arm is held rigid, the elbow stands off at a distance of 3 or 4 inches from the body, and the shoulder appears flat with a marked depression beneath the point of the shoulder. In addition there is pain and swelling at the site of injury, and the head of the humerus can be felt in an abnormal position as compared with the other side. Do not try to reduce this

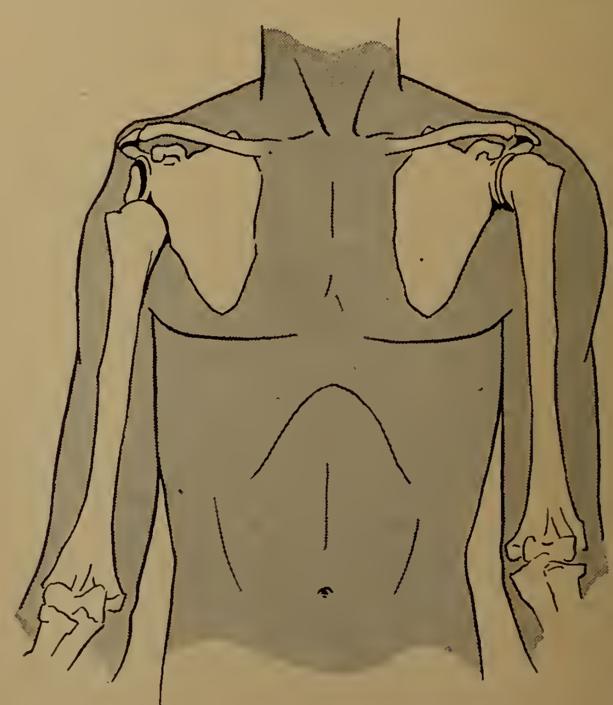


Figure 66.—Dislocation of the Shoulder.

dislocation if surgical assistance can be had in a few days; if not, follow this prescribed treatment.

Treatment

Place the patient upon his back on the deck or table. The operator takes off one shoe, inserts his heel under the armpit of the dislocated side, and makes traction upon the arm downward and slightly toward the patient's body. In doing this, care must be taken not to employ too great leverage action upon the arms, as a fracture might be produced. After reduction, immobilize the joint with a Velpeau bandage without the pad in the armpit, and keep the arm bandaged for a week.

If the dislocation fails to be reduced by these methods, do not persist in attempting reduction, as it is a case for operative surgery.

Fractures

A fracture is a broken bone. It may be partial or complete. Tissues near the site of a fracture are injured also. If in doubt as to whether or not a bone is broken, always treat it as a fracture.

Classifications of Fractures

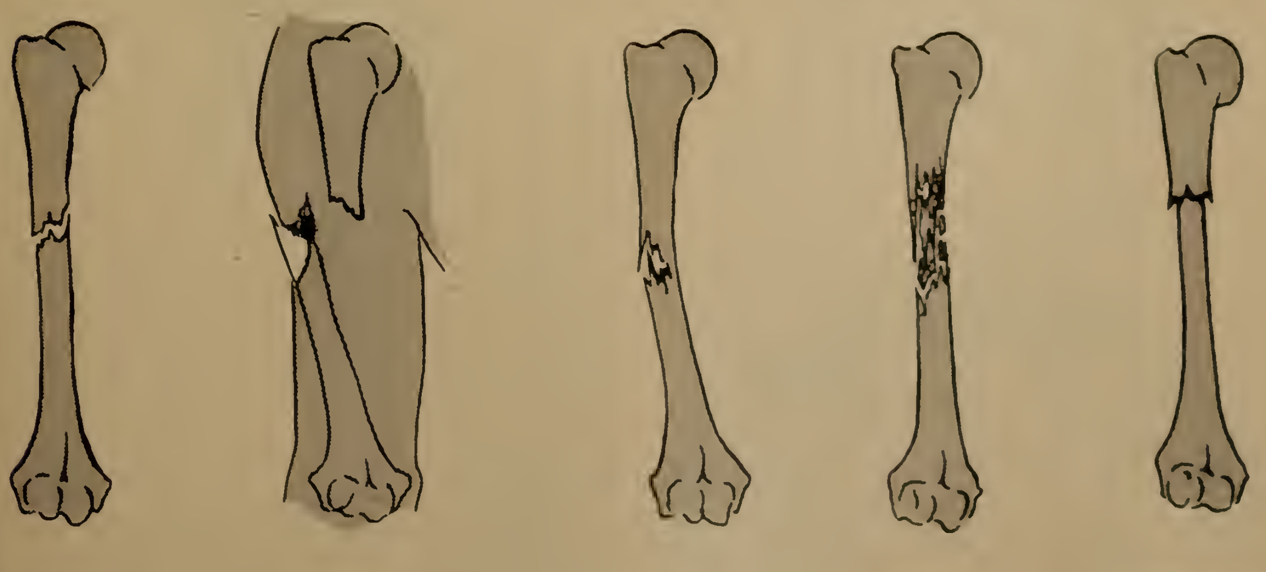
1. **Simple fracture.**—The bone is broken but the surrounding tissues and skin are unbroken.
2. **Compound fracture.**—The bone is broken and there is an open wound in the soft tissues leading from the skin surface to the region of the fracture.
3. **Greenstick fracture.**—The bone shaft is bent and cracked but not completely broken through.
4. **Comminuted fracture.**—The bone is crushed, splintered, or broken into a number of fragments.
5. **Impacted fracture.**—A fragment of bone is forcibly driven into another and remains more or less fixed in that position.

An X-ray examination is ordinarily the only means of making an accurate diagnosis, especially in head injuries, but the symptoms of pain, loss of function, and deformity are easily recognized by the corpsman and enable him to determine the proper method of treatment and evacuation.

Concussion and Skull Fracture

Whether or not the skull is fractured is not as important as the possibility of an injury to the brain. First aid efforts should not be concerned with whether or not the patient has a fractured skull. The primary treatment at the scene of an accident would be the same whether the skull is fractured or not.

The term concussion is often used incorrectly to describe any or all effects of head injury. Concussion of the brain is indicated by a brief period of unconsciousness immediately after a head injury. If concussion is prolonged, it may indicate



SIMPLE COMPOUND GREENSTICK COMMINUTED IMPACTED

Figure 67.—Types of Fractures.

more serious effects on the brain, such as bruising, tearing, or hemorrhage. Patients who have been unconscious even for a short time should be regarded as having potentially severe head injuries and should be kept quiet until examined by a physician.

The **symptoms** of head injury vary greatly, and patients with injuries which appear relatively mild at first may later develop symptoms of serious effects caused by pressure on the brain from swelling with fluid and hemorrhage.

At the scene of an accident, one can usually determine an injury to the head by appearance on it of a bump or laceration. The patient may be dazed or unconscious. There may be bleeding from the ears, nose, or mouth in severe cases. The pupils of the eyes may be unequal in size. Partial paralysis may result from injury to the head.

Treatment of Skull Fracture

1. Keep the patient lying down, with his head and shoulders slightly raised if his face is flushed red in color. If his face is pale, keep the patient level, or lower his head slightly.
2. Move him only in a horizontal position, handling him carefully and avoiding unnecessary movements.
3. Don't give stimulants.
4. Keep the patient warm, but do not apply hot water bottles or other heated objects to the unconscious patient.
5. If hemorrhage is profuse, it may be controlled by direct pressure.
6. Get the patient to a hospital as soon as possible.
7. **Do not give morphine.**

Figures 68.—Fracture of the Skull.

Fracture of the Nose

There is usually considerable deformity (the bridge of the nose being depressed and pushed to one side), crepitus generally can be felt, and there is considerable nosebleed. Return the bones to their normal position, if possible, by gentle manipulation. To hold the bones in position, apply two very small rolls of narrow bandage on either side of the nose and hold in place with short strips of adhesive plaster. Check the hemorrhage by syringing the nostrils with hot or cold water, or, if necessary, pack the nostrils with

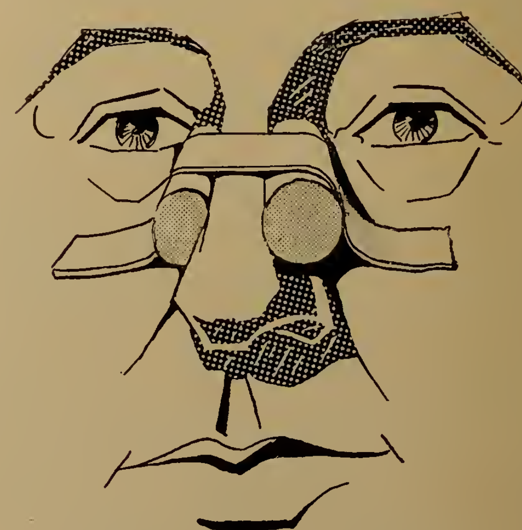


Figure 69.—Treatment of Fracture of the Nose.

cotton. Warn the patient not to blow his nose. Have this patient brought under the care of a physician as soon as possible.

Fracture of the Jaw

A broken jaw can generally be recognized by difficulty in talking, eating or swallowing, and by pain upon movement of the jaw. Usually the patient has suffered a sharp blow to the jaw. The teeth are usually out of line. Considerable swelling may develop later.

Treatment

1. Pain may ordinarily be controlled with aspirin or codeine.
2. Ice bags can also be employed to relieve pain and keep down swelling.

3. Hold the jaw in place and prevent excessive movement by applying a 4-tailed or Barton bandage.
4. Give the patient a liquid diet.
5. Refer the patient to a medical or dental officer as soon as possible.

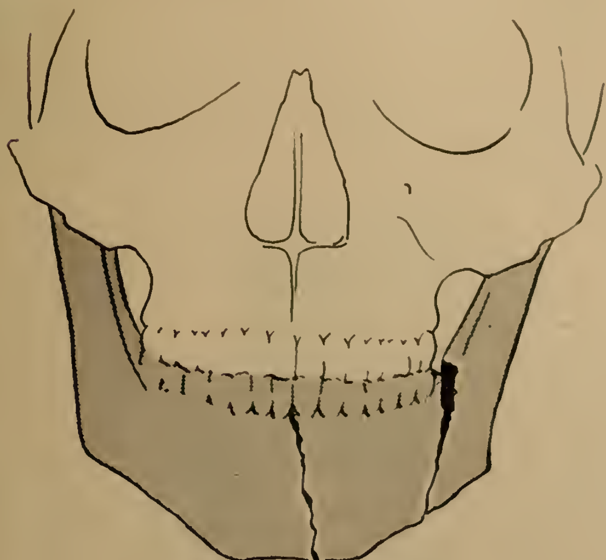


Figure 70.—Fracture of the Jaw.

Figure 71.—Bandage for a Fractured Jaw.

Fracture of the Neck

A fracture of the neck is usually caused by a rather violent accident in which the patient either falls on his head or receives a severe blow to the neck region. If such an accident results in pain, inability to move the neck, or an unnatural position of the head, one should suspect a fracture of the neck: that is, of the spinal column. It is very important that the head be maintained in a stationary position during transportation of the patient.

Treatment

These fractures are immobilized by a high collar which tends to lengthen the neck and raise the chin so as to arch the neck backward. A simple collar can be improvised from an artillery shell container. The cardboard cylinder is cut with a knife into a collar about 5 inches high. It is split on one side, pulled apart, and placed around the

Figure 72.—Immobilization for Fracture of the Neck.

neck. Pad well with felt or similar material. It is held closed by means of adhesive tape. A similar type of splint can be improvised with a newspaper or other material.

Fracture of the Clavicle

In a fracture of the clavicle the attitude of the patient is characteristic: the shoulder drops downward, inward, and forward, and he attempts to support it by holding the elbow of the injured side in the hand of the sound side. Since the collar bone lies immediately under the skin, the fracture is easily made out from the deformity and localized pain and tenderness.

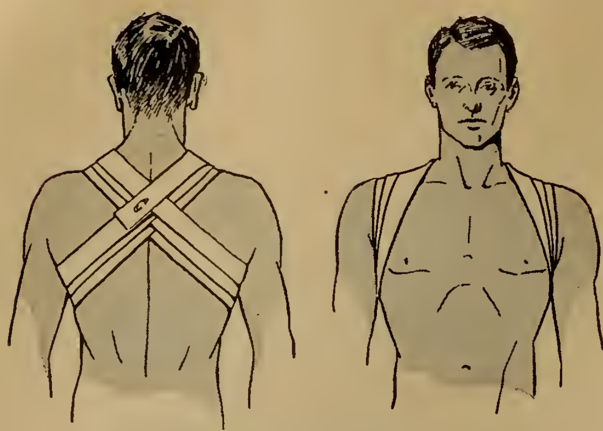


Figure 73.—Bandage for Fractured Clavicle.

Treatment

1. The figure-of-eight bandage may be used; it holds the shoulders backward and immobilizes the fracture. Be sure that it is firmly applied.

2. First pad the axillae to prevent the bandage from cutting. Hold the end of a 3-inch bandage on the outside of the shoulder and carry the roller diagonally downward across the shoulder blades, around the axilla, and over the shoulder of the opposite side. Continue downward across the shoulder blades to the axilla and up over the shoulder to the starting point. Repeat the procedure for three additional turns, overlapping the preceding turn by one-third its width. Secure the ends with a pin or adhesive plaster.

3. Transport this patient to a medical officer at once.

Fracture of the Humerus

Fractures of the shaft of the humerus present all of the usual signs of a fracture. The arm feels wobbly, pain is felt, crepitus is present. Fractures near the elbow are known as elbow fractures. When they occur with the elbow in complete extension they are sometimes called extension fractures. The arm is found in complete extension, or nearly so, and should be left that way. Fractures in this locality are serious from the liability of the joint to become stiff, and the patient should be brought under the care of the surgeon as soon as possible.

Treatment

1. A fracture of the neck or upper third of the bone may be treated temporarily by placing a pad or folded towel in the armpit and securing to the side with a bandage, then placing a sling about the wrist. With this dressing the weight of the arm and forearm acts as an extension.

2. Fracture in the middle of the shaft of the bone may be treated by the use of two broad splints, or four narrow ones placed about the seat of injury and secured by a bandage or strips of adhesive plaster, the wrist being supported by a sling. Care must be taken that the splint does not extend too high in the armpit, as it might compress the blood vessels or at least be exceedingly painful.

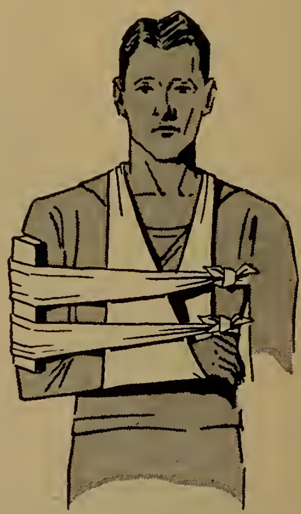


Figure 74.—Treatment of a Fractured Humerus.

3. A fracture near the elbow joint may be dressed temporarily by applying a large sling and securing the arm to the body.

Fracture of the Bones of the Forearm

When both bones of the forearm are fractured all the usual signs of fracture are present. When only one bone is broken, the other acts as a splint and but little deformity will be apparent, but there is inability to use the forearm; on examination, tenderness and a false point of motion can be discovered at the seat of injury. With a fracture of the radius alone—low, down, and just above the wrist—there is a well marked deformity, termed a silver-fork deformity, which is a symptom of the fracture of the radius spoken of as Colles fracture. In this fracture the tip (styloid process) of the lower end of the ulna is often broken off, and there may be rupture of the internal lateral

ligament of the wrist. As the bones are usually impacted, no grating or crepitus is present.

Treatment

In treating fractures of the forearm, one should put the limb up with the elbow bent at a right angle, the forearm across the chest, the palm of the hand turned in, and the thumb pointing upward.

1. First reduce the deformity by gentle traction upon the hand and then apply two well-padded splints to the seat of the fracture, making sure

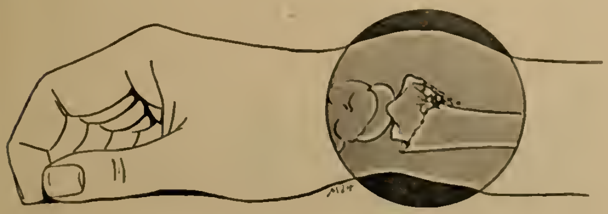


Figure 75.—Colles's Fracture.

that they are long enough to extend from the elbow to below the wrist.

2. Bandage the splints and support the forearm by means of a sling.

3. It is very important that all cases of Colles's fracture should be brought under the care of a surgeon as soon as possible, as the deformity is apt to be permanent unless the fracture is properly reduced and treated.

Fracture of the Rib

The symptoms are pain or stitch in the side and some difficulty in breathing. Pain may be especially severe if the patient coughs or sneezes or breathes deeply. The danger in rib fracture is injury to the lung, and with this complication there may be spitting up of blood and escape of air beneath the tissues of the chest wall, a condition called emphysema. On examination by passing the fingers along each rib in succession, one will be able to find a local point of tenderness and often a false point of motion or grating in one or more of them. By placing the ear against the injured side and asking the patient to take a deep breath, one may hear grating distinctly.

Treatment

In treatment of fractured ribs it is impossible to splint only one or two ribs. In order to immobilize the fracture it is necessary to immobilize the whole side on which the fracture has occurred. This splinting can be temporarily accomplished with a broad binder of muslin, a triangular bandage, or an ordinary roller bandage firmly wrapped around the chest, but the best method is to strap the chest with adhesive plaster wide enough to cover the injured side, about 8 or 9 inches wide and long enough to extend from the spine behind to just beyond the median line in front, and apply as follows:

1. With the patient standing with arms above the head, tell him to let all his breath out; as he does this, quickly apply the plaster to the injured side, starting just a little to the other side of the spine in the back and bringing the strap to just beyond the middle line in front.

2. The plaster is applied at the end of a forced expiration, because at this time the broken fragments are more nearly in apposition. In place

Figure 76.—Strapping a Fractured Rib.

of a single strip of plaster, several strips, each about $2\frac{1}{2}$ inches wide, may be applied, beginning well below the fracture and gradually working up.

3. Apply each strip with firmness at the end of a forced expiration, allowing it to overlap one-third of the one below.

4. When there is injury to the lungs accompanied by spitting up of blood, keep the patient quiet in bed and give cracked ice by mouth.

5. Get this patient to a physician as soon as possible.

Fracture of the Spine

In fractures of the spine, the spinal cord is generally injured or cut across, with resulting

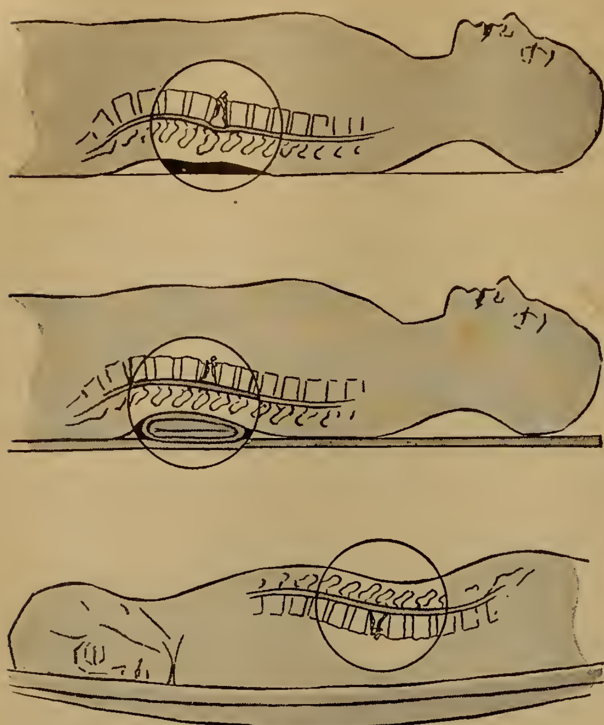


Figure 77.—Proper Position for Transporting a Patient with Fractured Spine.

paralysis to all parts below the fracture. On passing the fingers down the spine, one will note irregularity of the spinous processes with deformity as well as local pain over the site of the fracture.

Treatment

1. Keep the patient perfectly quiet and lying flat on his face until surgical aid can be obtained.
2. If it is necessary to move him, it should be done with extreme care to prevent any additional injury to the spinal cord.
3. Although the desirable position for a fracture of the spine is on the abdomen, for long transportation it is more comfortable to the patient to lie on his back. When such a patient is found lying on his abdomen, enlist the help of several assistants and gently roll him onto the board, placing plenty of padding under the small of his back. The padding keeps the fractured vertebra separated and protects the spinal cord from injury.
4. Tie the patient to the board to hold him while he is being transported.
5. Never let a suspected spinal fracture be lifted or assume a sitting position.
6. The most important thing to remember is that the sharp bone fragments will cut the spinal cord if they are moved. This will result in permanent paralysis of the body and legs.

Fracture of the Pelvis

The patient is unable to sit up or stand and complains of great pain and a sense of coming apart. Crepitus may be felt on strong pressure. These fractures generally are accompanied with injury to the internal organs and more or less shock. With injury to the bladder, blood is passed in the urine.

Figure 78.—Immobilization for Transportation of Fractured Pelvis.

Treatment

1. For first aid, move the patient carefully and only in a lying position on his back on a rigid stretcher, door, or board.
2. Bandage the knees and ankles together and either bend or straighten the knees, depending on which position is most comfortable.
3. The patient's bed should also be fixed so that it will not sag under his pelvis and the thighs should be supported with pillows.
4. In case of hemorrhage from the bladder, which indicates a rupture of that organ, a catheter should be introduced and left in, so that the urine will not accumulate and escape into the peritoneal cavity.
5. A urinary antiseptic, methenamine (urotropin), should be administered by mouth.

Fracture of the Femur

The patient usually lies with the toes of the injured limb pointing outward; any attempt to move the limb results in a spasm of the muscles and causes the patient excruciating pain. There is loss of power in the limb; the patient is unable to lift it. On examination, if the fracture is on the shaft of the bone, a false point of motion is discovered. By measurements the fractured limb

Figure 79.—Immobilization for Transportation of Fractured Femur.

is found to be shorter than the other one, due to the pull of the powerful thigh muscles.

Treatment

1. Apply two splints, one from the outside reaching from the armpit to beyond the foot and one on the inside from the crotch to the foot. The splints should be tied in five places—around the ankle, over the knee, just below the hip, around the pelvis, and just below the axilla. It is well to tie both limbs together.

2. The patient must be brought under the care of a surgeon as soon as possible, as an anesthetic is frequently necessary to effect reduction.

3. A traction splint or other means of extension is generally required.

4. Do not move these cases without splinting.

Fracture of the Patella

This fracture may be caused either by a blow or by muscular action. Usually you can feel a groove of separation in the kneecap. The usual symptoms of fracture are present.

Figure 80.—Immobilization for Transportation of Fractured Patella.

Treatment

1. The two fragments can be brought together by strips of adhesive plaster, one strip passing above the upper fragment and the other below the lower one.

2. In place of adhesive plaster a figure-of-eight bandage may be applied.

3. The patient should be put to bed with the injured leg elevated on a pillow.

4. Ice should be applied to the joint with the object of limiting and decreasing the swelling.

For first aid, straighten the limb. Use a board that will reach from the buttock to the heel and that is at least 4 inches wide. Pad well with extra padding under the knee and just above the heel. Apply one band strip just above the knee and one just below the knee; and also put one at the ankle and one on the thigh. Leave the kneecap exposed because the swelling may be rapid.

Fracture of the Lower Leg

When both bones of the leg are broken, the usual signs and symptoms of fracture are present. These fractures often are compound. If only one bone is broken, the other acts as a splint and deformity will not be so marked, but there will be present a local point of tenderness, swelling, and probably discoloration of the skin. Fracture of the lower end of the fibula is spoken of as a Pott's fracture. Pott's fracture is generally accompanied by tearing of the internal lateral ligament of the ankle joint or by a fracture of the internal malleolus, in which case there is great

Figure 81.—Pott's Fracture and Immobilization for Transportation.

deformity and turning out (eversion) of the foot. In case it is purely a fracture of the lower end of the fibula, there may be few of the usual signs of fracture and the injury may be mistaken for a sprain.

Treatment

1. Reduce any deformity by traction in the long axis of the limb.

2. Apply three well-padded splints—two side splints and a posterior one. In case of Pott's fracture do not apply a posterior splint. The latter is to give support and prevent a backward sagging at the seat of the fracture. A pillow and two side splints also make an excellent temporary dressing. A pillow covered by a pillow case is placed upon the deck, and the injured leg is laid carefully upon it; the edges of the pillow are then brought around the foot and limb and are pinned in place; finally the two side splints are applied outside of the pillow and are secured in place by straps of adhesive plaster or strips of bandage.

Splints

Splints are agents for immobilizing a fractured part. There are two general classifications of splints, traction splints, and coaptation splints.

Traction splints are those which, in addition to immobilizing a fracture, are constructed in such a manner that by their use extension and counterextension can be applied without the use of other apparatus for this purpose.

Coaptation splints are those which are used solely to immobilize the fracture.

Traction splints are indicated in fractures where there is much muscle pull tending to displace the fragments. The most common traction splints are the Thomas leg splint and modifications of the same, the Jones humerus traction splint, the Army hinged half-ring thigh and leg splint (Keller), the wire ladder splint, and the Cabot posterior wire splint. To obtain extension by use of these splints, adhesive strips or tapes are fastened to the skin and attached to the distal end of the splint, while counterextension is obtained by the push of the other end of the splint against the body.

In an emergency any material which has sufficient firmness to give support to a limb will answer for coaptation splints. Examples are: umbrellas, canes, swords, scabbards, guns, cigar boxes, wire, leather, laths, tent pins, pillows, or a folded coat. In fractures of the thigh and leg, the sound limb may be used as a splint. Plaster of paris bandage may be used. Adhesive plaster generally is used to splint a fractured rib. Any materials used for splints must be light but sufficiently rigid to prevent bending; long enough to reach the joints above and below the fracture; broad enough to prevent pinching of the limb in bandaging; and sufficiently padded to protect the part from undue pressure.

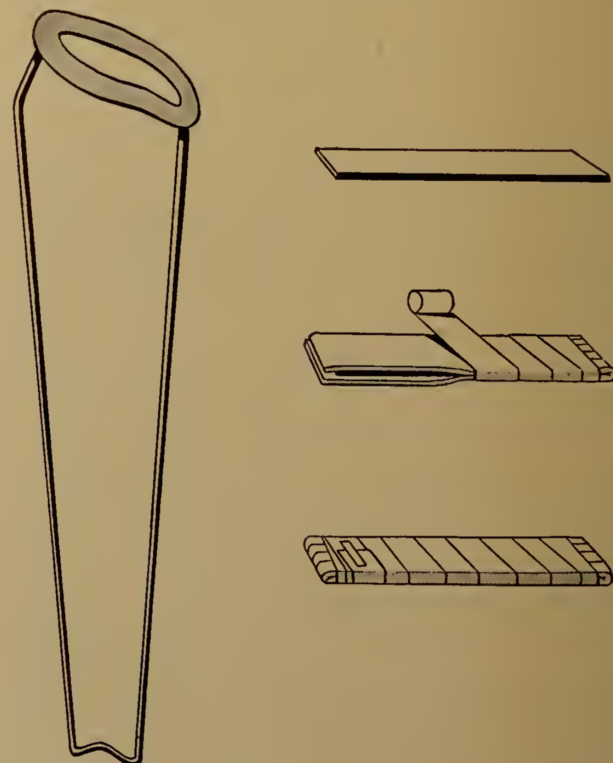


Figure 82.—Thomas Splint for Traction and Type of Coaptation Splint.

Coaptation splints may be applied temporarily over the clothing and should always be well padded, as a hard board against an injured limb soon becomes very painful. Oakum, cotton, grass, moss, portions of clothing, or any soft material will answer for the padding. If possible, two splints should be applied to a limb, while in fractures of the leg three generally are used, one on each side and one behind. In applying splints, have an assistant hold them in position and then firmly fasten them to the limb by several turns

of a roller bandage, adhesive strips, handkerchiefs, pieces of rope, or portions of clothing.

While splints should be applied snugly, care should be taken not to apply them too tightly for fear of cutting off the blood circulation; leave the tips of the fingers and toes exposed and watch the circulation. If the tips of the fingers are blue and cold, or if, upon pressing upon the nails, the normal pink color does not quickly return, the dressing is too tight. Remember that although a splint may be applied with the proper degree of snugness, later swelling of the fractured limb may cause it to be too tight. The use of plaster of paris as splinting material should be left to the surgeon.

BANDAGES AND BANDAGING

Bandages are employed to hold dressings applied to the surface of the body, to secure splints in the treatment of fractures and dislocation to create pressure, to immobilize joints, and to correct deformity. Various materials are employed in making bandages, such as gauze, flannel, crinoline, muslin, linen, rubber, and elastic webbing. Gauze frequently is used because it is light, soft, thin, porous, readily adjusted and easily applied. Flannel, being soft and elastic, may be applied smoothly and evenly; and as it absorbs moisture and maintains body heat, it is very useful for certain conditions. Crinoline, rather than gauze, is used in making plaster of paris bandages, as the mesh of the crinoline holds the plaster more satisfactorily than gauze.

Muslin is employed in making bandages because it is inexpensive and readily obtainable. It should be soaked in water to cause shrinkage, dried, and finally ironed to remove wrinkles. A large piece of this material may be torn easily into strips of the desired width. Rubber and elastic webbing are used to afford firm support to a part. The webbing is preferable to the pure rubber bandage, as it permits the evaporation of moisture.

A hospital corpsman should become familiar with the general rules of bandaging and proficient in the application of the various types of bandages. The comfort of a patient, the security of the dressing, and the professional reputation of the hospital corpsman depend on the proper application of a bandage. A neatly and properly applied bandage is an indication that the dressing covered by the bandage has been properly performed. An untidy, uncomfortable, insecure, improperly applied bandage may reasonably lead one to suspect that the underlying dressing is of the same character and can result only in adverse criticism.

Various types of commonly used bandages are the roller bandage, the triangular bandage, and the many-tailed bandage. The roller bandage is made from one of the aforementioned materials, with the width and length depending upon the part to be bandaged. For convenience and ease of application, the strip of material is rolled into the form of a cylinder. Each bandage of this type should consist of only one piece that is free from wrinkles, seams, selvage, and any imperfections that may cause discomfort to the patient.

Although there are various types of mechanical appliances used in winding bandages, it is essential that hospital corpsmen should be able to roll a bandage by hand. This is done in the following manner: The strips of bandage material should be folded at one extremity several times to form a small, firm cylinder. This cylinder is held by its extermities with the index finger and thumb of the left hand. The free end of the bandage is held between the index finger and the thumb of the right hand, close to the cylinder. With this hand the bandage then is revolved around the cylinder, which is held in the left hand, the free fingers of which aid in turning the cylindrical roll. The amount of tension exerted upon the free end will determine the firmness of the completed roller. A roller bandage consists of the free end or initial extremity, the body, and the terminal extremity in the center of the cylinder.

Triangular Bandage for the Head

Used to retain dressings on the forehead or scalp. Fold back the base of the bandage about 2 inches, thus making a hem. Place the middle of the base on the forehead just above the eyebrows with the hem on the outside. Let the point fall over the head and down over the occiput (back of the head). Bring the ends of the triangle around the back of the head above the ears, cross them over the point and carry them around to the forehead and tie in a square knot. Hold the dressing firm with one hand and with the other, gently but firmly pull down on the point until the

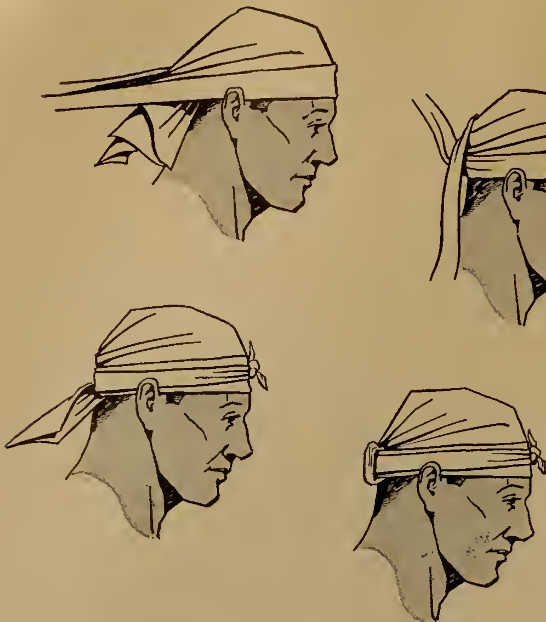


Figure 83.—Triangular Bandage for Head.

dressing is snug; then bring the point up and tuck it over and in the bandage where it crosses the occiput.

Triangular Bandage for Shoulder

Used to hold dressing on the upper arm or shoulder, but two triangular bandages are necessary. Fold the first one into a narrow cravat. Place the base of the cravat on the top of the shoulder on the injured side and bring the ends across the back and chest respectively; continue under the opposite axilla and tie in front with a square knot. Before tying knot place a pad in the axilla on the uninjured side to prevent pressure by the narrow cravat. Turn up the base and make a hem of the second triangular bandage and apply it to the arm on the injured side. Carry the ends around behind the arm; cross and tie them in front.

Support the dressings firmly with one hand and with the other, tuck the point of this triangle under and over the cravat on the shoulder until the dressings are held snugly in place. Pin the point to secure it. If no pin is available, the point of the triangular bandage can be folded under the cravat several times before the cravat bandage is applied. Remember, do not tie the ends around the arm too tightly. Check the distal circulation frequently.

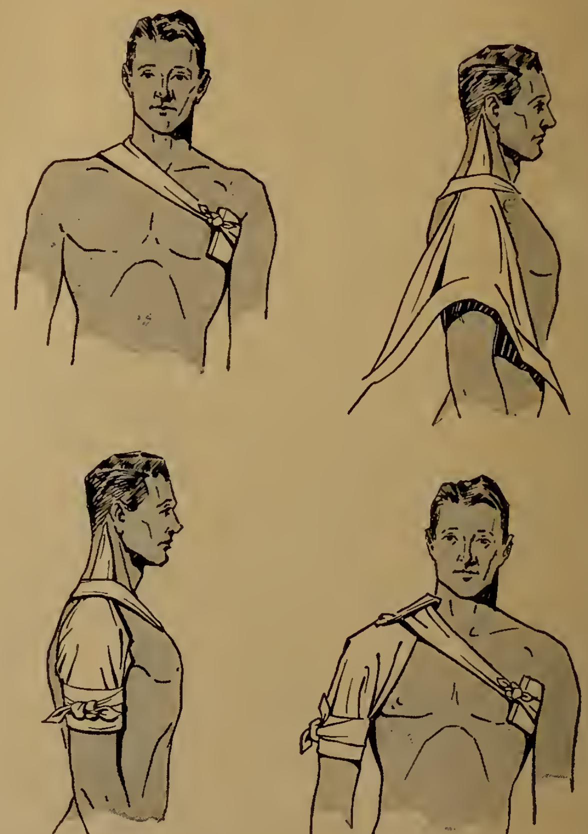


Figure 84.—Triangular Bandage for Shoulder.

Triangular Bandage for Chest or Back

Used to retain large dressings on the chest or back. For the chest drop the point of the triangle over the shoulder on the injured side, letting the

Figure 85.—Triangular Bandage for Chest or Back.

base fall down over the injured area. The middle of the base should be directly below the shoulder. Bring the ends around the body to the back and tie them in a square knot directly below the shoulder. If the base hangs too low below the wound, it may be shortened by folding it over several times before tying. This leaves one long end. Tie this long end to the point of the triangle lying over the shoulder, completing the procedure. Reverse the procedure for a back bandage, tying the ends over the chest.

Triangular Bandage for Hip

Used to retain dressings on the buttock or hip. Make the first triangular bandage into a narrow cravat and tie it around the abdomen, with the knot on the uninjured side. Take the second

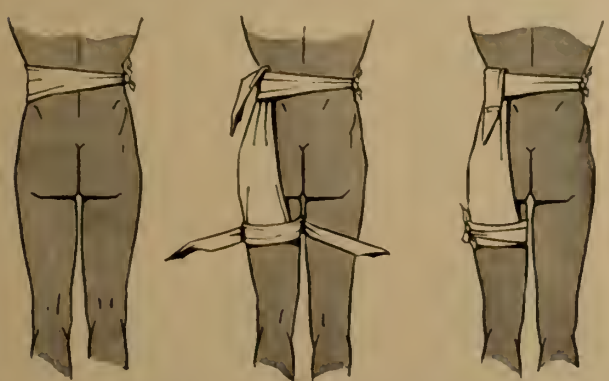


Figure 86.—Triangular Bandage for Hip.

triangular bandage and tuck its point up under the cravat, letting the base hang down over the thigh on the injured side. Make a hem along its base to the height desired and carry the ends around the thigh; cross in back and tie them on the outer side of the thigh. Hold the dressings in place and gently pull the point until they are well supported; then secure the point with a safety pin or tuck under.

Triangular Bandage for Foot

Used to retain large dressings on the foot. After the dressings are applied, place the foot in the center of a triangular bandage and carry the point over the ends of the toes and over the upper side of the foot to the ankle. Fold in excess bandage at the side of the foot, cross the ends and tie in a square knot in front.

Triangular Bandage for Hand

Used to retain large dressings on the hand. After the dressings are applied place the base of the triangle well up on the palmar surface of the wrist. Carry the point over the ends of the fingers and back of the hand well up on the wrist.

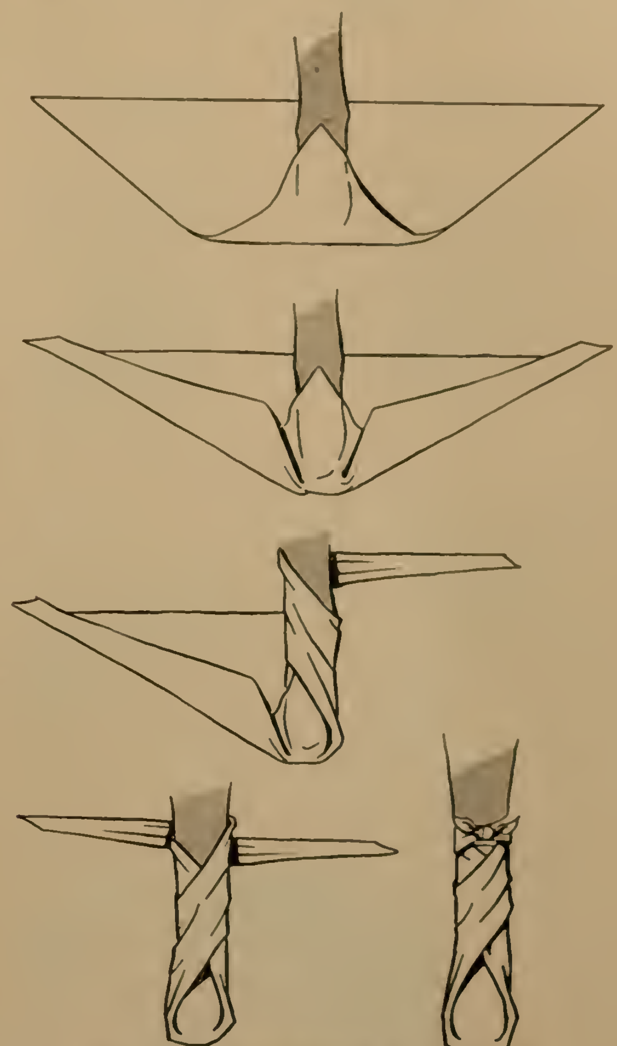


Figure 87.—Triangular Bandage for Foot or Hand.

Fold the excess bandage at the sides of the hand in folds, cross the ends around the wrist, and tie in a square knot in front. (See fig. 87.)

Cravat Bandage

To make a cravat bandage, bring the point of triangular bandage to the middle of the base and continue to fold until the desired width is obtained.

Cravat Bandage for the Head

This bandage is very useful to control bleeding from wounds of the scalp or forehead. After placing the dressing over the wound, place the center of the cravat over the dressing and carry the ends around to the opposite side; cross them and continue to carry them around to the starting point and tie with a square knot.

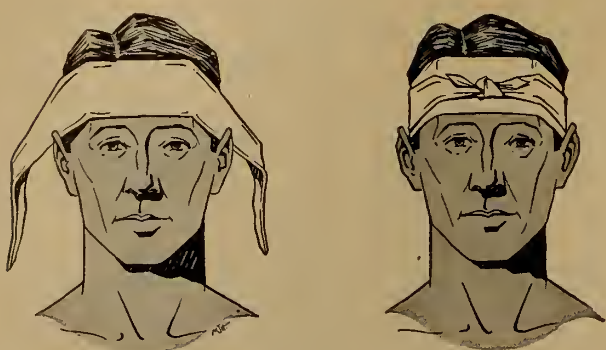


Figure 88.—Cravat Bandage for the Head.

Cravat Bandage for the Eye

After applying a dressing to the affected eye, place the center of the cravat over the dressing and on a slant so that the lower end is inclined downward. Bring the lower end around under the ear of the injured side and the other end over the ear on the opposite side. Cross the end in back of the head; bring them forward and tie them over the dressing.

Figure 89.—Cravat Bandage for the Eye.

Cravat Bandage for the Temple, Cheek, or Ear

After the dressing is applied to the wound, place the center of the cravat over it and carry one end over the top of the head and the other under the jaw and up the opposite side, crossing them at right angles over the temple on the injured side. Continue one end around over the forehead and the other around the back of the head to meet over the temple on the uninjured side. Tie ends with a square knot.

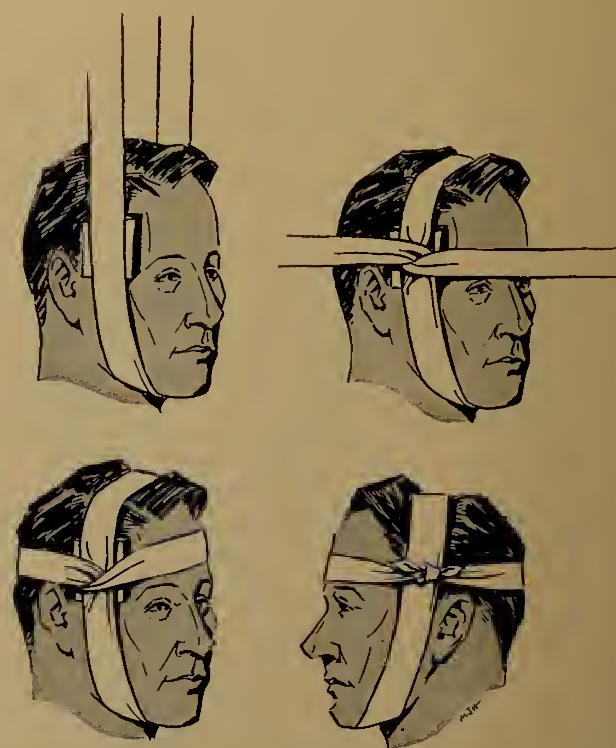


Figure 90.—Cravat Bandage for the Temple, Cheek, or Ear.

Cravat Bandage for the Elbow or Knee

After applying the dressing to the elbow or knee, and if the injury or pain is not too severe, bend it to a right angle position before applying the bandage. Place the middle of a rather wide cravat over the point of the knee or elbow and carry the ends around the upper part of the elbow or knee, bringing it back to the hollow, and the lower end entirely around the lower part, bringing it back to the hollow. See that the bandage is smooth and fits snug, then tie with a knot outside of hollow.

Figure 91.—Cravat Bandage for the Knee.

Figure 92.—Cravat Bandage for the Elbow.

Cravat Bandage for the Arm, Forearm, Leg, or Thigh

The width of the cravat to use will depend upon the extent and area of the injury. For a small area, place the dressing over the wound and center the cravat bandage over the dressing. Bring the ends around in back, cross them, and tie over the dressing. For a small extremity it may be necessary to make several turns around in order to use all the bandage before tying. If the wound covers a larger area, hold one end of the bandage above the dressing and wind the other end spirally downward across the dressing until it is secure, then upward and around again and tie a knot where both ends meet.

Cravat Bandage for the Axilla (Armpit)

This cravat is to hold dressings in the axilla. It is similar to the bandage used to control bleeding from the axilla. Place the center of the bandage in the axilla over the dressing, and carry the ends up over the top of the shoulder and cross them. Continue across the back and the chest, respectively, to the opposite axilla and tie them. Do not tie too tight or the axillary artery will be compressed, adversely affecting the circulation of the arm.

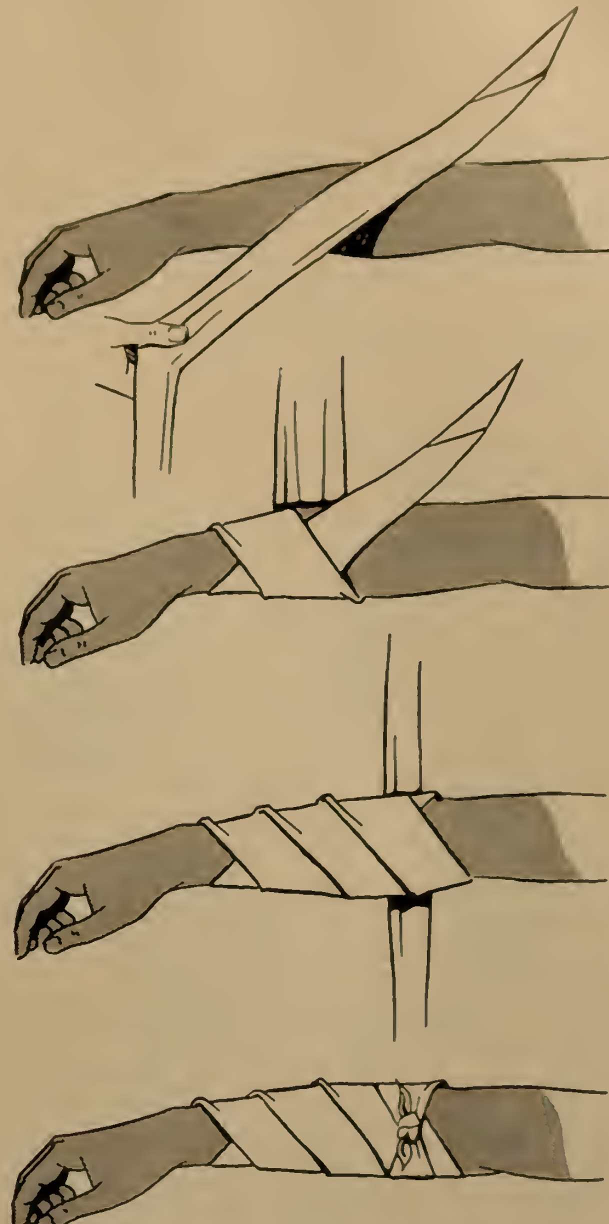


Figure 93.—Cravat Bandage for the Arm, Forearm, Leg, or Thigh.

Figure 94.—Cravat Bandage for the Axilla.

Cravat Bandage for a Sprained Ankle

Do not remove the shoe. Leaving it on will afford partial support. If the top of the shoe is above the ankle, loosen the laces to allow for swelling. Use a narrow cravat and begin by placing the middle of the bandage under the heel; carry the ends back and upward crossing above the heel and around forward, crossing over the instep. Now continue downward and backward again, this time close to the ankle and under the first turn, make a hitch and bring the ends forward, then around the ankle once more and tie over the instep.

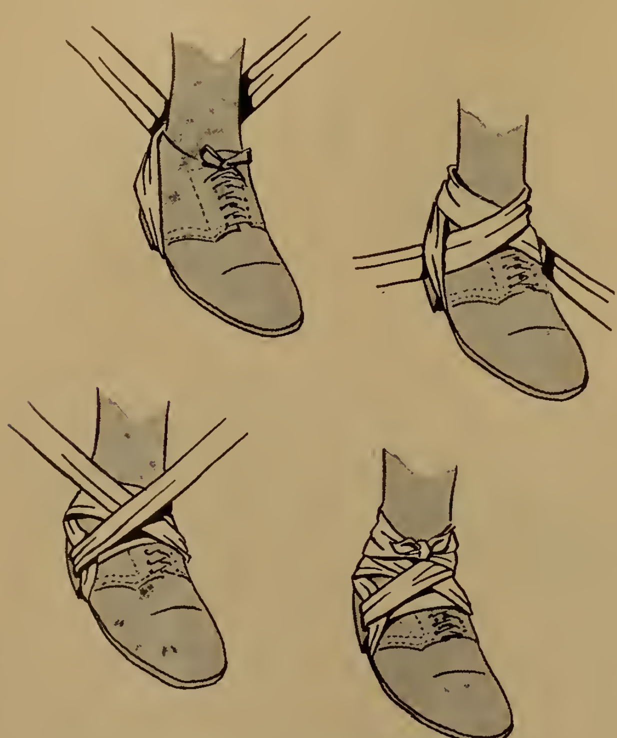


Figure 95.—Cravat Bandage for a Sprained Ankle.

Roller Bandage

In applying a roller bandage the roll should be held in the right hand so that the loose end is on the bottom; the outside surface of the loose or initial end is next applied to and held on the part by the left hand, and the roll is then passed around the part by the right hand, which controls the tension and application of the bandage. Two or three of the initial turns of a roller bandage should overlie each other in order to secure the bandage and keep it in place. In applying the turns of the bandage it is often necessary to transfer the roll from one hand to the other.

Bandages should be applied evenly, firmly, and not too tightly. Excessive pressure may cause interference with the circulation and may lead to disastrous consequences. In bandaging an extremity it is therefore advisable to leave the fingers or toes exposed in order that the circulation of these parts may be readily observed. It is likewise safer to apply a large number of turns of a bandage rather than to depend upon a few too firmly applied turns to secure a splint or dressing.

In applying a wet bandage, or one that may become wet in holding a wet dressing in place, it is necessary to allow for shrinkage. The turns of a bandage should completely cover the skin, as any uncovered areas of skin may become pinched between the turns, with resulting discomfort.

In bandaging an extremity it is advisable to include the whole member (arm and hand, leg and foot), excepting the fingers and toes, in order that uniform pressure may be maintained throughout. It is also desirable in bandaging a limb that the part be placed in a position it will occupy when the dressing is finally completed, as variations in flexion and extension of the part will cause changes in the pressure of certain parts of the bandage.

The initial turns of a bandage of an extremity (including spica bandages of the hip and shoulder) always should be applied securely and, when possible, around the part of the limb that has the smallest circumference. Thus in bandaging the arm or hand the initial turns usually are applied around the wrist, and in bandaging the leg or foot the initial turns are applied immediately above the ankle.

The final turns of a completed bandage usually are secured in the same manner as are the initial turns, by the employment of two or more overlying circular turns. As both edges of the final circular turn are necessarily exposed, they should be folded under to present a neat, cufflike appearance. The terminal end of the completed bandage

is turned under and secured to the final turns by either a safety pin or adhesive tape. When these are not available, the end of the bandage may be split lengthwise for several inches, and the two resulting tails secured around the part by tying.

Roller Bandage for the Hand and Wrist

For the hand and wrist a figure-of-eight bandage is ideal. Anchor the dressing, whether it be on the hand or wrist, with several turns of a 2- or 3-inch bandage. If on the hand, anchor the dressing with several turns and continue the bandage diagonally upward and around the wrist and back over the palm. Make as many turns as necessary to properly secure the dressing.

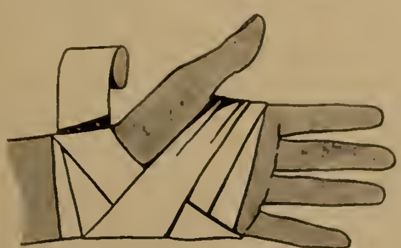


Figure 96.—Roller Bandage for the Hand and Wrist.

Roller Bandage for the Ankle and Foot

The figure-of-eight bandage is also used for dressings of the ankle as well as for supporting a sprain. While keeping the foot at a right angle, start a 3-inch bandage around the instep for several turns to anchor it. Carry the bandage upward over the instep and around behind the ankle, forward and again across the instep and down under the arch, thus completing one figure-of-eight. Continue the figure-of-eight turns overlapping one-third to one-half its width, with an occasional turn around the ankle, until the dressing is secure or until adequate support is obtained.

Figure 97.—Roller Bandage for the Ankle and Foot.

Roller Bandage for the Knee

The spica or figure-of-eight bandage of the knee is similar to that of the elbow and is used to retain dressings in the region of the knee joint. Make two circular turns around the thigh just above the knee and carry the bandage diagonally downward across the kneecap and encircle the leg below the knee with another circular turn. Carry the bandage diagonally upward, again crossing the kneecap to the basic anchor turn. Make another circular turn, repeat the figure-of-eight procedure, overlapping each previous turn about two-thirds the width of the bandage, and gradually ascend the knee. Secure the bandage with several circular turns above the knee and tie. To secure the dressings in the hollow of the knee, reverse the procedure and cross the bandage in the back.

Figure 98.—Roller Bandage for the Knee.

Roller Bandage for the Heel

The heel is one of the most difficult parts of the body to bandage. Place the free end of the bandage on the outer part of the ankle and bring the bandage under the foot and up. Then carry the bandage over the instep, around the heel and back over the instep to the starting point. Overlap the lower border of the first loop round the heel and then repeat, the turn overlapping the upper border of the loop around the heel. Continue these turns until the desired number of turns is obtained and secure with several turns around the lower leg.

Figure 99.—Roller Bandage for the Heel.

Roller Bandage for the Elbow

A spica or figure-of-eight type of bandage is used around the elbow joint to retain dressings over wounds in the region of the elbow and to allow a certain amount of movement. Flex the patient's forearm slightly, if you can do so without causing him too much pain, and anchor a 2- or 3-inch bandage above the elbow with two circular turns. Carry it diagonally downward across the hollow of the elbow and encircle the forearm below the elbow with a circular turn. Continue the bandage diagonally upward across the hollow of the elbow to where you started; make another circular turn around the upper arm, carry it downward, repeating the figure-of-eight procedure, and gradually ascend the arm. Overlap each previous turn about two-thirds of the width of the bandage. Secure the bandage with two circular turns above the elbow and tie. To secure dressings on the tip of the elbow, reverse the procedure and cross the bandage in the back.

Roller Bandage for the Forearm, Leg, and Thigh

The spiral reverse bandage must be used to cover wounds on these parts; only such a bandage can keep the dressing flat and even. Make two or three circular turns around the lower or smaller part of the limb to anchor the bandage and start upward, going around and around, overlapping about one-third to one-half the width of the

Figure 100.—Roller Bandage for the Elbow.

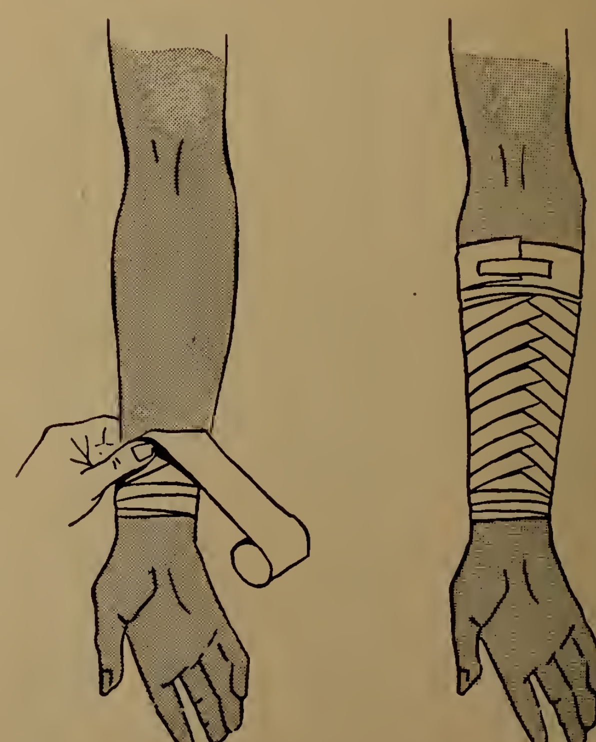


Figure 101.—Roller Bandage for the Forearm, Leg, and Thigh.

previous turn, and continue as long as each turn lies flat. When the edge of a turn is loose it is then necessary to use the reverse lap. Continue the spiral, making the reverse laps when necessary, and secure the end when completed. Note that it is not necessary to reverse each turn as is described in most text books.

Velpeau Bandage

The fingers of the affected side are placed upon the opposite shoulder, a pad placed in the axilla, and the skin surfaces separated by sheet wadding. Place the initial end of the bandage across the outer portion of the affected shoulder, downward over the outer and posterior surface of the flexed arm, behind the point of the elbow, obliquely across the back of the forearm and chest to the opposite axilla, and around to the point of origin. After repeating this turn once, the bandage is carried from the point of origin across the back and side of chest, in front of the flexed elbow and transversely across the front of the chest. Then it is carried around the other side of the chest, diagonally across the back to the affected shoulder.

Figure 102.—The Velpeau Bandage.

The first turn then is repeated, followed by a second circular turn around the chest and flexed arm.

Each vertical turn over the shoulder overlaps two-thirds of the preceding turn, ascending from the outer part of the shoulder to the neck and from the upper posterior surface of the arm inward toward the point of the elbow.

Each transverse turn also overlies one-third of the preceding turn. These transverse turns are continued until the last turn covers the wrist. The bandage is finally secured with pins, both where it ends and at various points where the turns of the bandage cross each other. (The initial turns of this bandage may be secured by circular turns around the chest under the arm of the affected side.)

Uses.—Fixation of arm in treatment of fractured clavicle and fixation of humerus after reduction of dislocated shoulder joint.

Barton Bandage

With the initial end of the bandage applied to the head just behind the right mastoid process, the bandage is carried under the bony prominence at

Figure 103.—The Barton Bandage.

the back of the head, upward and forward back of the left ear, obliquely across the top of the head, downward in front of the right ear, under the chin, upward in front of the left ear, obliquely across the top of the head, crossing the first turn in the midline of the head, thence backward and downward to the point of origin behind the right mastoid, then it is carried around the back of the head under the left ear, around the front of the chin, under the right ear to the point of origin. This procedure is repeated several times, each turn exactly overlying the preceding turn. The bandage is secured with a pin or strip of adhesive tape, and either a pin or adhesive may be applied at the crossing on top of the head.

Uses.—Fracture of lower jaw and retention of dressings of chin.

TRANSPORTATION OF THE INJURED

The method of transporting a seriously injured person cannot be overemphasized. It is just as important as any other first-aid procedure. The patient's life as well as much of the further treatment may depend upon the manner in which you move and transport him after the accident.

General Procedures

1. The various methods of carrying should only be used to remove a patient from a dangerous area, such as a fire, or when it is the only means of transportation available. They should not be used unless the victim is only in need of slight support or when he is to be moved for only a short distance.

2. First, see that all hemorrhage has been arrested, fractures and dislocations immobilized, wounds dressed, pain controlled, and the treatment for shock instituted, if necessary, before moving the patient.

3. Protect the patient against exposure by covering him with a sufficient number of blankets, garments, or with whatever material is available.

4. Be gentle in moving him so you do not aggravate the patient's condition by rough handling.

5. Certain injuries require special handling in order that further injury is not produced and that splints and dressings do not come loose. See that the patient is transported or carried in such a way as to protect his injuries and that harmful pressure is not applied to the injured area.

6. A patient suspected of having a fractured spine should be transported in such a way that the spine is in a position of extension. This can be accomplished by placing a folded blanket or pillow under the small of the back.

7. Whenever possible, carry the stretcher to the patient and not the patient to the stretcher.

8. Secure the patient to the litter so that there is no danger of his falling out, and in case of a fracture of the neck or spine see that there is adequate immobilization.

9. Four men are necessary to carry the litter and an additional one, if available, can help to attend to the needs of the injured as he is being transported. See that you have an adequate number of bearers.

Tie Hands—Drag Carry

The "Drag" is used to drag or haul an unconscious patient from beneath a low structure and for a short distance. Tie the patient's wrists around your neck. By raising your shoulder, you will be able to lift his head and shoulders above the ground and drag him.

Figure 104.—The Drag Carry.

Chair Used as a Litter

A convenient method of carrying a person, particularly an ill person, without a stretcher is to seat the patient on a strong chair and have two bearers lift the chair. The chair must always be carefully tested for strength.

This method is valuable for carrying a patient up or down a ladder, particularly in places where a stretcher cannot be used because of narrow winding ladders or small doorways.

Figure 105.—Chair Used as a Litter.

Blanket Drag

Patient is placed on blanket and moved by pulling end of blanket. This type of transportation is excellent when patient is unconscious, with injuries which forbid handling or lifting by a single bearer.

Figure 106.—Blanket Drag.

Arm Carry

For patients not seriously injured, but who must be carried because they are unconscious or because walking would make their condition worse.

Figure 107.—Arm Carry.

Fireman's Carry

This is one of the easiest methods to carry an unconscious patient and one which has proven to be the most practical. Turn the patient on his face and kneel on one knee at the head of the patient, facing him. Place both hands under the armpits and gradually work them down the patient's side and across his back. Raise the victim to his knees; then take a firmer hold across the back and raise him to his feet. Next seize the right wrist of the patient with your left hand and draw his arm over your head and down your left shoulder.

At the same time reach down with your right arm and pass it around the victim's right thigh and grasp his right wrist. This leaves your left hand free. In lowering the patient the procedures are reversed. Should the patient be wounded in such manner as to require the procedure to be conducted from the right side instead of the left, simply change the hand and proceed in the same manner, substituting the right for left and vice-versa. (Fig. 108.)

One Man Supporting Carry

A patient who is only slightly injured may be assisted in walking by one bearer. The patient walks, leaning against the bearer's right side.

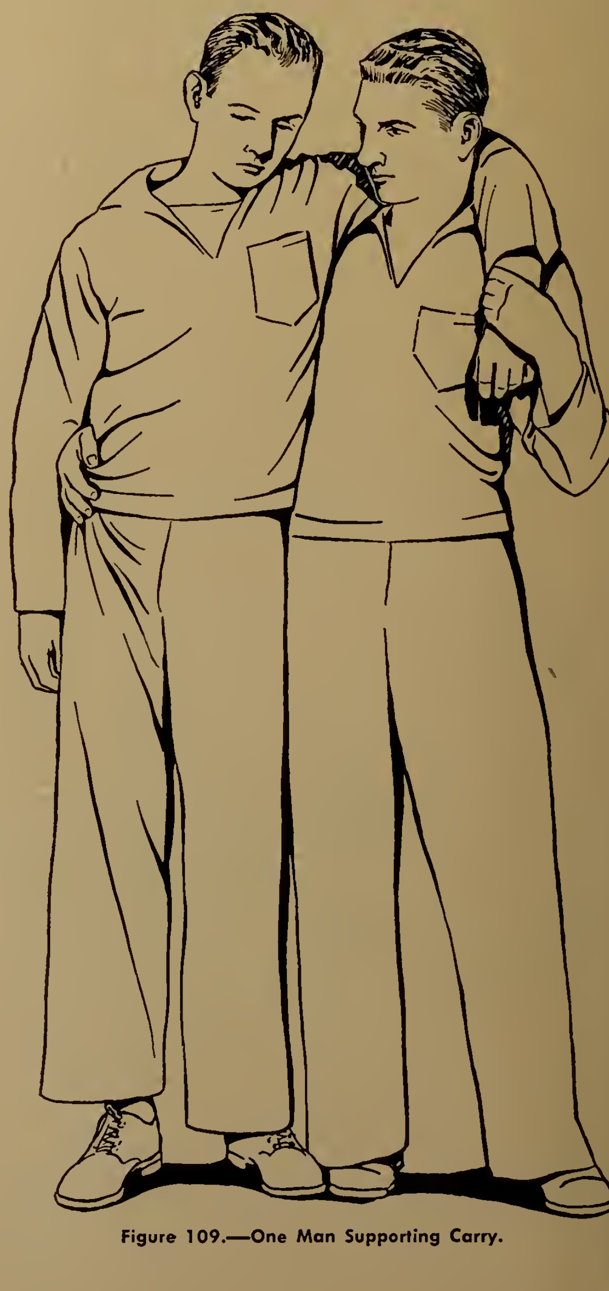


Figure 109.—One Man Supporting Carry.

Figure 108.—Fireman's Carry.

Pack Strap Carry

This is a valuable carry when the patient's injuries do not prohibit its use. A bearer can carry a greater weight with safety this way than in any other carry.

Bring the patient's arms across the bearer's shoulders, taking great care that the patient's armpits are well up on the shoulders. The arms are crossed in front where they may be held in place by one of the bearer's hands, thus leaving the other hand free. This is very useful in lifting a patient from a bed or chair.

Figure 110.—Pack Strap Carry.

Army Litter

The army litter is made essentially of canvas and is supported by wooden or aluminum poles. It is collapsible and is the most practicable for use in the field.

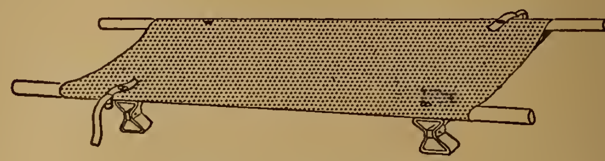


Figure 111.—The Army Litter.

Stokes' Stretcher

In most instances when the hospital corpsman is faced with the problem of transporting a severly injured person, the Navy's service litter called the Stokes' stretcher will be available. It is a wire basket supported by iron or aluminum rods. It is used aboard ship especially for loading patients to and from the boats.

Before placing the patient in a Stokes' stretcher, cover the stretcher with two blankets placed lengthwise, so that one blanket extends down each leg, and use a third blanket folded in half in the upper part of the stretcher to protect the head and shoulders. Lower the patient gently onto the stretcher and make him comfortable. Secure the patient's feet to the foot of the stretcher to prevent him from sliding up and down. Cover him with blankets and secure him in place by using the three straps and fastening them over his chest, hips, and knees.

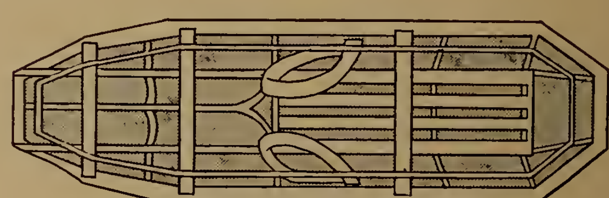


Figure 112.—The Stokes' Stretcher.

Neil Robertson Stretcher

The Neil Robertson stretcher officially adopted by the British Navy is especially adapted to transport casualties from engine rooms, holds and other compartments where access hatches are too small to permit the use of the Stokes' or Army litter. The stretcher is made of semirigid canvas and is wrapped around the patient like a mummy wrapping. This permits him to be hoisted out of these difficult places.

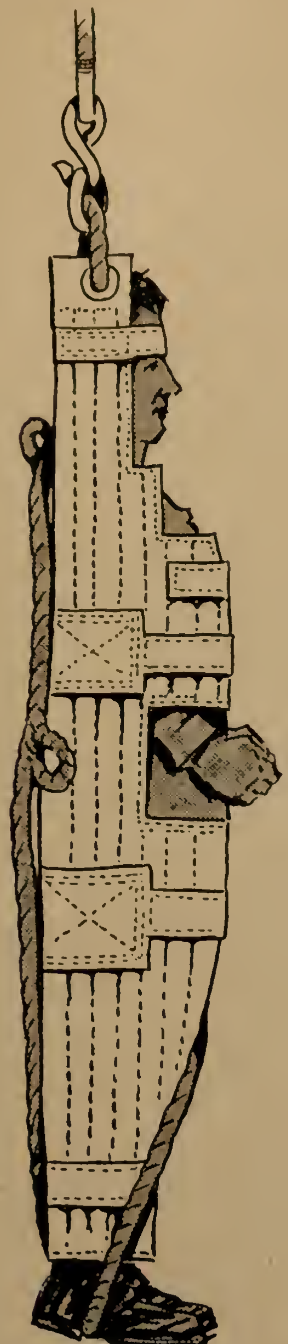


Figure 113.—The Neil Robertson Stretcher.

MISCELLANEOUS EMERGENCIES

Foreign Bodies in the Eye

Cinders, steel fragments, portions of emery wheels, particles of dirt, and eyelashes are the most common foreign bodies found in the eye. They may be under the upper or lower eyelid or on the cornea.

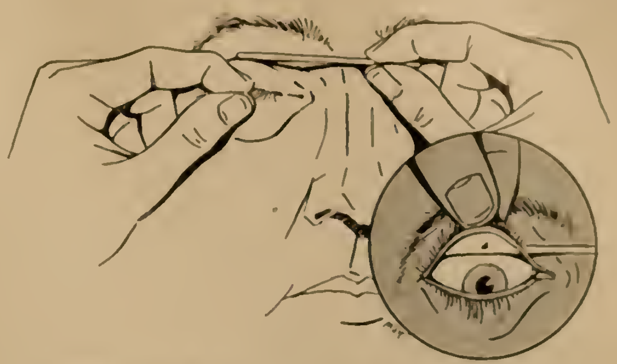


Figure 114.—Removing a Foreign Body from the Eye.

Removal

1. The lower eyelid should be pulled down first. if the foreign body is seen, it may be removed on the tip of a small cotton swab which has been moistened with boric acid solution.

2. The upper lid may be examined by standing back of the seated patient whose head is inclined backward. Have the patient look down, grasp the eyelashes and turn back the upper lid over a smooth applicator or probe. If the foreign body is seen, remove with small cotton applicator moistened with boric acid solution.

3. If the foreign body cannot be seen on the upper lid, examine the eyeball. If seen, try removing it with a fine wire loop curette. Use a quick flicking motion. Do not drag wire loop across the cornea. To aid the patient it may be necessary to instill one or two drops of pontocaine solution in the eye. If there is no wire loop available, use a small cotton swab moistened with boric acid solution. Use a quick flicking motion. Do not drag across the cornea. If these methods fail, do not try anything else. Instill a small amount of pontocaine ophthalmic ointment, cover the eye with an eye patch or dressing, and get patient to a medical officer as soon as possible.

4. After the object is removed, irritation may cause the patient to complain that the object is still in the eye. Apply a small amount of boric acid ophthalmic ointment to relieve the irritation.

5. If no foreign object can be found on examination, have the patient wash the eye with an eyecup, using boric acid solution. This may aid

in either removing the object, or bringing it into view where it can be seen and removed.

Caution: Never use a metal probe or eye instrument about the eye, other than a fine wire loop curette as described above, and as an aid in everting the upper lid. Any object which cannot be removed easily with the wire loop curette or cotton swab should be touched only by a medical officer.

Foreign Bodies in the Ears

Small objects may be introduced into the ear by children or insane patients; insects may enter at times when the individual is asleep; the usual foreign body is earwax which, in some individuals, forms and hardens rapidly.

1. An object may be removed by using a fine-wire curette if it can be seen.

2. Insects can be very annoying. Use two or three drops of a light oil, kerosene, or ether. Syringe with warm boric acid solution.

3. Do not syringe with water or boric acid solution if the object is of vegetable origin such as a pea, bean, or seed. This may cause them to swell and be difficult to remove. If they cannot be seen and easily removed, leave them alone until they can be removed by a medical officer.

4. Wax may be removed by irrigation with warm boric acid solution. If the wax is not removed, try placing a few drops of hydrogen peroxide or glycerin in the ear, then syringing after a few hours. This procedure may have to be repeated daily for several days before all of the hardened wax is removed. Let the peroxide or glycerin remain overnight each time, in difficult cases.

Foreign Bodies in the Throat

These may be fish bones, masses of food, or other objects which have been placed in the mouth.

1. If a fish bone, and it can be seen, it may be removed with forceps or fingers. If the bone cannot be seen, get the patient to a medical officer as soon as possible.

2. If a mass of food, try removing it by thrusting the fingers into the throat. If it cannot be removed, this may cause vomiting which may eject it.

3. If the object is causing difficulty in breathing, try placing the patient over a chair or bench with the head low and striking a sharp blow between the shoulders.

4. If the object cannot be removed easily, get the patient to a medical officer as soon as possible.

Foreign Bodies in the Stomach

Usually, these are not serious. If sharp pointed objects such as pins, tacks, brads or other sharp-edge objects are swallowed:

1. Do not give laxatives of any nature.

2. Feed patient foods with considerable bulk, such as bread, potatoes, and bananas.

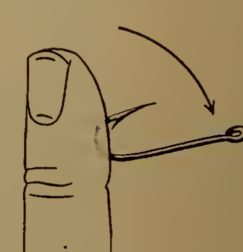
3. Get the patient under the care of a surgeon as soon as possible.

Foreign Bodies in the Skin

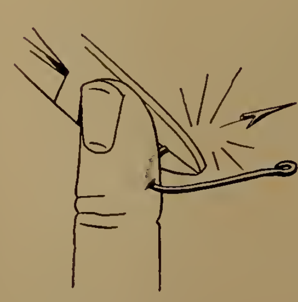
These may be splinters, thorns, needles, pins, fishhooks, glass, nails, and similar objects. Many foreign bodies cause absolutely no symptoms and it is better to leave them alone. Many persons carry bullets or small pieces of shrapnel in their bodies with no symptoms or inconvenience.

1. Splinters and thorns may be removed by passing the point of a knife or forceps under the

1. Showing hook buried in finger. Barb prevents removal.



2. Barb pushed through skin.



3. Barb clipped off.

4. Barbless fishhook withdrawn.

Figure 115.—Removing a Fishhook from the Finger.

objects and with the thumbnail press the splinter against the blade.

2. To remove objects from under a nail, cut a notch in the nail to expose the end of the object, then it may be removed.

3. Some objects such as a needle or fishhook may be pushed through the part and removed. It is best to cut off the end of a fishhook before removing. (Fig. 115.)

After objects are removed, treat as any wound. Cleanse, apply disinfectant such as tincture of merthiolate and apply sterile dressing.

Rings on swollen fingers can usually be removed using soap or petrolatum. It may be necessary to cut it with a wire cutter or file, being careful to protect the finger.

Heat Stroke—(Sun Stroke)

Cause.—Exposure to excessive heat. Usually the direct rays of the sun.

Symptoms.—Headache, dizziness, frequent desire to urinate, irritability, disturbed vision, usually objects have a red or purplish tint. Patient suddenly falls unconscious; skin dry and hot; pupils contracted; pulse full, strong, and bounding; may be convulsions; temperature of body from 105° to 109° F.

Treatment.—This condition is serious. Reduce the temperature rapidly.

1. Remove the patient to shade or coolest place available.

2. Remove clothing. Lay patient on back with head and shoulders slightly elevated.

3. Pour cold water over body, or if available, place in tub of cold water.

4. Rub body with ice. Place piece of ice in armpits. Ice cap on head.

5. Cover with sheets soaked in ice water.

6. If temperature does not readily reduce, use cold salt water enemas, 1,500 to 3,000 cc., frequently.

7. Give cool (not iced) drinks after consciousness returns.

8. Do not give stimulants.

Heat Exhaustion (Heat Cramps)

Caused usually by loss of salt and water from the body by perspiration. Excessive heat. Under the same conditions one person may develop heat exhaustion, another heat stroke. Heat exhaustion is more frequently found in hot, humid places, as firerooms aboard ship.

Symptoms.—Dizziness; profuse perspiration; nausea and vomiting; fainting; muscle cramps; skin, pale, moist, cool; temperature subnormal; pulse, weak, rapid; pupils usually dilated; shallow respirations; usually aroused easily.

Treatment.—1. Remove to cool area.

2 Keep lying down; treat for shock.

3. Keep warm. Give stimulants.

4. Give freely hot water or coffee to which has been added one-half tablespoon salt to each glass or cup.

5. Muscle cramps may be relieved by hot applications or immersion of part in hot water. Hot water bottles may help give relief.

6. Morphine, ¼ grain, may be given to relieve muscular cramps if necessary.

NOTE.—It has been shown that it is desirable for men working in high temperatures to drink water containing 0.1 to 0.3 percent salt. Salt tablets are available for issue and should be placed where readily accessible to all personnel. Excessive amounts of salt should be avoided as it will lead to thirst, gastrointestinal irritations, nausea, diarrhea, and a decrease in the efficiency of personnel. Men should be encouraged to drink water in excess of the amount required to quench thirst, as it is more beneficial under these conditions.

Frostbite

Frostbite is the term usually applied to injuries resulting from exposure to dry cold.

Immersion or immersion foot is the term usually applied to injuries resulting from prolonged immersion of the part in cold water. This condition is found frequently among survivors of shipwrecks, especially the feet, due to sitting on life rafts with feet in the water.

Treatment for both conditions is for all practical purposes the same.

1 If conscious, and feet are affected, do not permit patient to walk.

2. Get patient into a moderately warm room, undressed as quickly as possible.

3. Immerse in bath at 105° to 110° F. for 10 minutes.

4. Dry carefully and place in bed, keep covered, but do not permit cover to come in contact with affected parts.

5. Do not rub or massage parts. If hands or feet are affected keep slightly elevated, move

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frequently, support the part well, and protect pressure points with use of doughnut dressings.

6. Keep parts dry; dry, clean, sterile cotton between the toes and fingers.

7. Inject 300,000 units penicillin to help combat infection.

8. Get the patient to a hospital or under the care of a medical officer as soon as possible.

NOTE—When handling cases of frostbite, do not touch the skin any more than necessary. Massaging or rubbing the part will break the skin permitting infection to start more rapidly.

Do Not Rub the Parts With Ice or Snow!

EMERGENCY MEDICAL TREATMENT

The main objective of this section of the handbook is to present material that will aid the corpsman in the recognition of disease and will introduce a plan of conservative treatment that may be instituted for each disease and condition discussed. It is to be remembered that disease is very often not sharply demonstrated in the human body and therefore can present an extremely baffling picture. To be able to make a fine, differential diagnosis is not the problem of the hospital corpsman.

But while on independent duty, it becomes necessary for the corpsman to have a general knowledge of disease, a good understanding of the methods of recognizing disease, and the common sense ability to decide what the course of action shall be. Modern communication systems make contact with medical help possible in most situations. The corpsman should never hesitate to ask for help.

The corpsman should record accurately all observations made by him and all complaints given by the patient. He should not allow the facts to become "cool," but should write them down as soon as possible. He should record all treatments promptly. The more information the medical officer receives, the more quickly he will be able to diagnose the condition being considered.

Suggestions set forth here are limited in content. The hospital corpsman should have reliable and up to date reference books and current material at hand at all times so that he can keep abreast in the field of medical science and thus be able to meet situations promptly and with a greater degree of assurance.

Diagnosing, Clinical Observation, Sample Radio Dispatch

Points to be remembered in diagnosing:

History of illness.—Consider a patient who comes to you as an individual, not as an illness or condition. Try to consider how the ailment affects the individual as a whole.

Size up the patient. Let him tell you his story. Make all your questions direct and simple.

Try to determine the severity of his condition. Is it progressing rapidly or slowly?

When was the onset? Remember, a condition that has been going on for a long time without change usually is not something about which one needs to become alarmed. If the onset has been a matter of hours or even a day or two with progressive change for the worse, an attempt should be made immediately to determine the nature of the illness.

If the patient's statements give you no clue, attempt to localize the condition to one of the systems of the body through questioning. Begin with the head and go down the body, asking questions related to the various systems.

The head

Discharge from ears.
Ringing in the ears.
Loss of hearing.
Discharge from nose.
Nose bleed.
Frequent head colds.
Tooth trouble.
Headache.

Cardio-respiratory system

Pain in chest.
Palpitation.
Dyspnea.
Night sweats.
Spitting up blood.
Cough—type of cough.

Gastrointestinal system

Eating habits—Is appetite good? Can he eat all foods? Or must he watch his diet?

Gas or heartburn after meals.

Vomiting blood (coffee grounds).

Bowel habits—diarrhea, constipation, pain (if so, where is pain), are cathartics necessary, bright blood or tarry stools, hemorrhoids.

Abdominal pain—where, type, relation of pain to meals. Does it occur afterward or between meals?

Urinary system

Frequency of urination.

Pain or burning sensation.

Amount of urine—appearance of (smoky, cloudy, puslike, bloody, dark amber color).

Genital system

Presence of VD lesion at any time.

Inflammation.

Pain—type.

Enlargement of glands.

Neuromuscular system

Loss of memory.

Moods, disposition.

Nervousness.

State of mind.

Ask about pain and motility of joints; cramps in muscles.

Habits

Coffee, smoking, drinking, drugs.

Sleep, personal hygiene.

Possibility of working habits affecting person; e.g., a man with headache, vertigo, muscular weakness, vomiting, stupor, who comes in contact with fumes from furnaces or engines, might be suspected of carbon monoxide poisoning.

Physical examination (after eliciting as much information from the patient as possible, a physical examination may be necessary).

Vital signs

Take TPR and blood pressure.

Head

1. Note any swelling or growths.

2. Tenderness—over sinuses or mastoids.

3. Look at eyes for unequal pupils, unusual movement of eyeballs; check eyes for accommodation to light.

4. Nose—swelling; does it appear to be broken; note discharge, obstruction.

5. Mouth—tongue coated, very red, very dry. Any decayed teeth. Gums bleeding or inflamed. Any eruptions or discolorations in mucous membranes. Throat condition red; membranes or pus present. Condition of tonsils if present.

Neck

Check lymph nodes behind ears, down side of neck, and over collar bone. Any enlargement in area of thyroid or other parts of neck.

Chest

1. Is a cough present? Was development of cough rapid or slow? Could it be due to postnasal drip of sinusitis?

2. Listen for rales (moist, crackling sounds) with stethoscope if one is available.

3. Check sputum—is it clear, mucoid, green or yellow pus, or bloody?

4. Heart—pains in the heart that are of sticking nature, occurring intermittently, are usually due to excitement or tension. Crushing pain in chest with radiation to the sternum and down the left arm is of serious nature. Blood pressure and pulse readings are of consequence in connection with the latter.

Gastrointestinal tract (palpate the abdomen).

Have patient lying on back, undressed. Make certain your hands are warm. Gain patient's confidence and relax him by pressing abdomen gently in area where there is no pain. Gradually move your hand toward any tender spots.

1. In appendicitis, there usually is rebound tenderness; i. e., when suddenly releasing the left side of the abdomen, pain will occur in the right side.

2. Perforated peptic ulcer—sudden excruciating pain in abdomen with boardlike rigidity.

3. Distention should be noted.

4. Pain of any type; colicky, generalized, localized, etc.

5. Note movement of abdomen during respirations; e. g., in abdominal injuries oftentimes the patient breathes only with the thoracic muscles.

Genitourinary system

1. If pain is present in kidney area, it may radiate down into the groin and genitalia. To examine, place one hand on the abdomen, one under the back of loin. Upon gentle palpation one feels the muscles are rigid in the loin. Tenderness in the region may also be present. The other side should also be palpated for comparison.

2. Check urine carefully for albumin, pus, blood. Microscopic examination should be done if possible. Remember any time disturbances occur in the kidneys, bladder, or ureters, evidence of this can be found in the urine.

3. Examine genitalia for enlargement, lesions, redness.

Extremities

1. Check for injuries—type.
2. Is pain present; if so, where?
3. Note swelling.
4. Is entire limb involved, or is the condition localized.
5. Upon moving joints, note if movement is smooth or crackling.

After the history and physical examination are completed, positive findings should be noted and a tentative diagnosis made.

Radio dispatch at sea for advice in care of sick or injured

General points to be remembered:

Ship information, such as latitude, longitude, destination, etc., is an administrative problem and will be supplied by the officer responsible for the same.

The place to radio will depend upon circumstances and ship's location.

Write the message in your own words, being sure to leave out any unnecessary words, and then submit it to the executive officer.

Accuracy and completeness of information cannot be overemphasized. The listing below includes the points concerning the patient that should be considered when composing a radio dispatch:

Patient's age.

Description of type of pulse and respiration, especially if the patient is acutely ill.

Patient's mental state—conscious, stuporous, delirious, etc.

If the temperature was taken rectally or by axilla—this must be mentioned.

Onset and duration of illness. Is there a progressive change for the worse.

Brief history.

Habits of individual that may have bearing on his condition.

Principal complaints.

Associated symptoms of note, including urinalysis if possible.

In the case of injuries, cause, location, amount of bleeding, deformity caused by the injury, and other significant signs should be included.

Treatment you have instituted.

Make sure you confine all statements to facts as found by you when you examined the patient and as related to you by the patient.

Sample message (as you might prepare it):

Request advice and treatment concerning Brown, Hugh T., SN, age 20; conscious; speech—clear, coherent.

History, symptoms.—Onset sudden—2 hours ago, hard chill, immediate rise in temperature. No previous attack. Past history negative except for cold last week.

Temperature 104. Pulse 136, regular, strong. Respirations 38, quiet, labored, cause pain right side chest. B. P. 124/82. Chest pain aggravated by breathing, coughing. Expectorating small amount thick blood, streaked sputum. Patient looks toxic. No other cases on board.

Treatment.—To bed. Aspirin, 10 grains, procaine penicillin 300,000 units 1045. Forcing fluids. Light foods.

MEDICAL CONDITIONS

Angina Pectoris

Cause.—Occurs due to a slackened supply of fresh oxygenated blood to the heart muscle and oftentimes accompanies hardening of the arteries.

Symptoms.—Occur when the individual has exerted himself, either through exercise or some emotional strain. Pain—sudden pain that radiates over chest and sometimes down the left arm, also to the back. Is of a crushing nature, often described by the patient as feeling that his chest is in a vise. With rest the pain will generally subside. Dyspnea and tachycardia are usually present. Occasionally there may be digestive disturbances.

Treatment.—1. Rest, both physical and mental.

2. Nitroglycerin, 1/150 grain, under the tongue or inhalation of vapors from an amyl nitrite perle should bring relief from pain. Nitroglycerin may be repeated every 5 to 10 minutes for three or four doses. If pain has not been relieved in ½

hour, give ¼ grain morphine sulfate or 100 mg. of demerol subcutaneously rather than continue with the nitroglycerin. If nitroglycerin brings relief after one or more tablets, it may be repeated several times a day if necessary.

3. Discourage overeating, smoking.

4. Hospitalize for check-up as quickly as possible.

Coronary Thrombosis and Occlusion

Cause.—Unknown except that arteriosclerosis usually plays a part in bringing about total obstruction of one of the coronary vessels, either because of a clot or because of thickening of the arterial wall. Most prevalent in persons over 40.

Symptoms.—Pain — agonizing, compressing, crushing pain in chest that radiates down below the sternum, often down the left arm, up into the neck, and sometimes over the gastric region. If this pain lasts 30 minutes or longer, damage to the heart muscle can be considered serious. Color ashen. Symptoms of shock, such as a precipitate drop in blood pressure, a weak, rapid pulse, and cold, clammy skin. Increased respirations. After 12 to 24 hours, a moderate fever develops. Sedimentation rate and WBC later become elevated.

Treatment.—1. Make the patient as comfortable as possible where he is, and give morphine sulfate, ¼ grain, or demerol, 50 to 100 mg. subcutaneously without delay; repeat in 30 minutes if the pain has not been relieved.

2. When the pain subsides, move the patient to bed or bunk. Absolutely avoid all physical and mental strain on the part of the patient.

3. For cyanosis and anoxia, give oxygen.

4. Diet (see "Cardiac diet"), avoid iced or stimulating drinks.

5. This is a grave medical emergency and requires expert nursing care. Transfer by stretcher to a hospital as quickly as possible is imperative.

Diabetes Mellitus

See Nursing and Nursing Procedures.

Gastroenteritis

Cause.—Caused by any food, liquid, or drug that irritates the lining of the stomach and intestines. Preformed toxins or organisms which cause an infection of the gastrointestinal tract will produce symptoms of gastroenteritis.

Symptoms.—Will vary according to the severity of the irritation. Loss of appetite, followed by nausea and vomiting. Abdominal pain and diarrhea. Fever. Tenesmus. Sometimes bloody stools. Dehydration will follow quickly in severe cases.

Treatment.—1. Bedrest with bathroom privileges unless the patient is too ill.

2. Nothing by mouth during period of nausea and vomiting.

3. Tr. Belladonna gtt. XII to XV, as tolerated by the patient four times a day; paregoric 4 cc. every 4 hours for diarrhea.

4. For dehydration, 5-percent dextrose in isotonic saline 1,000 cc. I. V. daily; any additional I. V. fluids given should be 5-percent glucose in water.

After nausea subsides, clear liquids, such as bouillon, tea, and thin, cooked cereals may be given. Soft cooked foods (see chapter on diets) may be added as tolerated.

6. If the symptoms do not subside in a matter of 18 to 24 hours with the above treatment, if the patient is not vomiting frequently, and if fever is still present, aureomycin in the dosage of 250 mgs. every 6 hours by mouth may be helpful. If aureomycin is not available, chloromycetin or terramycin may be given, using the same dosage. Any one of these drugs may be given for several days, until the patient is brought under the care of a medical officer.

Acute Hepatitis

Cause.—Caused by filterable virus of two types: (1) SH virus (serum hepatitis) (2) IH virus (infectious hepatitis). The infection is passed from one person to another through contamination of foods or through breaks in the skin.

Symptoms.—Early, the patient may have gastrointestinal upset or oftentimes an upper respiratory infection. Loss of appetite, chilliness, headache. Nausea and vomiting may occur, oftentimes diarrhea. Pain and tenderness of liver just below ribs margin on right side. Urine is a dark brown color. Fever up to 103° F.; however, some cases may be afebrile or have a temperature of less than 100° F. Stools become light and pasty. Jaundice often seen in the eyes and under the tip of the tongue. (Observe in daylight). Generalized jaundice may follow.

Treatment.—Preservation of liver tissue is the first consideration. Hospitalization is in order as soon as possible. Emergency treatment:

1. Put to bed. Isolate if possible. Wash hands thoroughly each time after handling patient.
2. Fat free diet with additional protein. (See diet for liver conditions).
3. Fruit juices with sugar added.
4. Multivitamin tablet twice daily.
5. Avoid use of any drugs to prevent further liver damage.
6. Care of excreta, cleaning of dishes, bedpans, and urinals should follow procedures set forth in isolation technique.
7. Particular care must be exercised in the sterilization of all needles and syringes. The hepatitis virus is very resistant to many chemicals used for sterilizing. For this reason, only boiling or autoclaving of such equipment is acceptable.

Acute Nephritis

Cause.—Unknown. A predisposing cause is believed to be streptococcal infections, particularly of the respiratory tract.

Symptoms.—Puffiness (edema) of the eyelids in the morning, of the ankles at night. Nausea, headache, blurred vision, spots before the eyes. Urinary characteristics: decreased amount, smoky in appearance, albumin, blood, casts, pus. Temperature up to 100° F. Pulse and respirations increased in proportion to fever. Occasionally pain is present in the flank. The patient appears acutely ill.

Treatment.—1. Hospitalize immediately.

2. Handling of case until hospitalization is accomplished:
   a. Absolute bed rest.
   b. The diet is important. (Refer to diet for nephritis).
3. Restrict fluids.
4. Check the blood pressure daily.
5. Keep track of fluid intake and urinary output.

PEPTIC ULCER

The Uncomplicated Ulcer

Cause.—Unknown; however, it is associated with hyperchlorhydria of the stomach. Emotional factors seem to play a role.

Symptoms.—Chronic pain in the epigastrium of a gnawing, burning nature, appearing at the same time and in the same place in relation to meals. May radiate to the back under the scapula. Pain is relieved by foods or other measures that neutralize acids. A tendency to experience distention and discomfort often is an early symptom. Loss of weight may occur.

Treatment.—1. Hospitalization is not always necessary in mild cases, but a consultation with a medical officer should be requested.

2. Diet is of greatest importance to reduce acidity and coat the ulcer. (Refer to "Peptic ulcer diet").
3. Aluminum hydroxide with magnesium trisilicate 30 cc. may be given whenever necessary to neutralize acids.
4. For the emotional patient small doses of phenobarbital, ¼ to ½ grain four times daily may be helpful.
5. Cooperation of the patient is absolutely necessary for healing to take place.

The Bleeding Ulcer

Cause.—Bleeding is brought about by erosion of a blood vessel in the area of an ulcer.

Symptoms.—Weakness, dizziness, fainting sensations. Patient's color pale and shallow. Tarry stools. Sometimes emesis of coffee grounds vomitus. A moderate fever.

Treatment.—1. Absolute bed rest.

2. Morphine sulfate, ⅙ to ¼ grain, subcutaneously.
3. Nothing by mouth if patient is vomiting.
4. If not vomiting, institute milk and cream diet. (See "Peptic ulcer diet").
5. Check blood pressure and pulse at frequent intervals.
6. Check for further tarry stools or coffee grounds vomitus.
7. Intravenous fluids such as plasma should not be given unless there is a drastic drop in blood pressure. Too sudden rise in blood pressure caused by such fluids may create further bleeding.
8. Moderate fever is not an alarming feature. It is present due to absorption of toxins created.
9. Hospitalize as soon as possible.

Pleurisy

Cause.—Occurs most often as a complication to a primary chest condition, such as pneumonia or bronchitis.

Symptoms.—Pain below the scapula or in the region of the fifth and sixth ribs directly under the arm. The pain is usually experienced when the patient coughs or inhales and can range from a dull sensation to one of a sharp, stabbing nature. Temperature may be slight or as high as 104° F. The pulse rate rises with the fever. Breathing most often is shallow to prevent pain and increases in rapidity with the rise in temperature.

Treatment.—1. Aspirin, 10 grains, or Aspirin, Phenacetin and Caffeine Tablets 2, for pain PRN.

2. Increased fluid intake.

3. Adhesive straps may be applied to chest to relieve muscle spasm and pain. (See fractures for illustration of strapping chest).

4. If the patient does not respond to the above conservative treatment after a period of 24 to 48 hours and still has an elevation of temperature, he may receive either aureomycin, chloromycetin, or terramycin in doses of 250 mg. every 6 hours. Hospitalization or consultation should be requested as soon as possible.

Respiratory Infections

The common cold, bronchitis, pneumonia:

Cause.—Most often a filtrable virus, although bacteria are sometimes the causative agents.

Symptoms.—The severity of the symptoms will depend upon the disease present. Onset is more often gradual than sudden. Headache, malaise, chilliness, sore throat. A cough is invariably present in pneumonia and bronchitis. Pain in chest. Sputum—purulent in bronchitis, bloody in pneumonia. Elevated temperature, pulse, and respirations.

Treatment.—1. Bed rest.

2. Isolation, if possible.

3. Aspirin, 10 grains, as needed.

4. Nose drops of ¼-percent neosynephrine every 4 hours.

5. Steam inhalations.

6. Elixir terpin hydrate for cough.

7. Force fluids.

8. Easily digested foods. (See "Fever diet").

9. For severe conditions, such as pneumonia, antibiotics are in order. If it is impossible to admit such a patient to a hospital immediately, the drugs of choice are aureomycin or chloromycetin, 500 mg. for the initial dose, and 250 mg. thereafter every 6 hours. Do not exceed a total of 12 grams.

Rheumatic Fever

Cause.—It is now widely believed that the hemolytic streptococcus plays an important part in both the primary as well as the recurrent attacks of rheumatic fever.

Symptoms.—Often preceded by sore throat or a cold, particularly of streptococcal origin. Onset is often dramatic, though at times it is insidious, and as such, may run its course unnoticed. One or more of the larger joints, such as the shoulder or knee, become painfully swollen, red, and hot. These symptoms are often found to migrate from one joint to another. Fever sometimes up to 104° F. The pulse and respiratory rates increase in proportion to the fever. White blood count and sedimentation rate are increased. Patient's color is often very pale, and he usually perspires quite profusely.

Treatment.—If immediate transfer to a hospital is impossible, the following should be done:

1. Absolute bed rest.

2. Aspirin, or sodium salicylate, 15 to 20 grains, three times daily after meals.

3. For diet, refer to "Fever diet."

4. Additional vitamins may be given; fluids should be taken freely.

5. For local relief of pain, application of oil of wintergreen and wrapping the affected joint are helpful. Pads of cotton covered with gauze are applied to the painful area and then held in place by means of bandage.

6. Good nursing measures, such as bed baths, keeping the patient dry, supporting the affected joint, and guarding from chilling are very essential.

7. Irregularities of the pulse beat and shortness of breath are danger signs for possible heart damage. Observe closely for this.

Prognosis.—Unless there is heart damage, the patient usually recovers without further difficulty in the course of several weeks. With heart involvement, the prognosis is greatly altered: for

this reason, a patient who complains of joint pains, even though the pains are vague, should be observed closely for several days. Sedimentation rate, TPR should be taken for several days to determine if there are changes. It has been found that if a person who has had rheumatic fever later develops a sore throat or has a cold of streptococcal origin, there may be a recurrence of rheumatic fever. For this reason, a person giving a history of rheumatic fever should receive penicillin when symptoms of a sore throat develop. Such a procedure will often prevent further development of rheumatic fever.

Poliomyelitis

Cause.—An acute infection, of a virus nature, which affects the nervous system, and may result in complete paralysis of various muscle groups. At times it occurs in serious epidemic form usually during the summer months, affecting children more frequently than adults.

Symptoms.—In many cases the symptoms may be so mild that the illness is not noticed. They may disappear in 1 to 3 days and the individual not realize that he has been affected. Sudden onset of fever periods, headache, sore throat, restlessness, stiff back, stiff neck, spasms of various muscles, muscle pains, loss of reflexes, and paralysis.

Treatment.—Any patient with the above symptoms, especially sudden onset of fever—sore throat, who appears at the sick bay, during the summer months in an area where poliomyelitis is known to be present, or who, on questioning, has recently been in an area where it is known to exist, should be considered as a suspicious case until a medical officer has examined the case, or the symptoms have subsided for a period of several days.

1. Isolate if possible. Isolate mess gear and linens. Use all precaution, especially wash hands well after handling.

2. Complete bed rest. It has been demonstrated that those persons who continue physical activity after mild onset are more susceptible to paralysis than those who are placed completely at rest.

3. Watch closely for development of paralysis. Muscular spasms may be relieved by application of hot wet packs for 20 minutes, several times a day.

4. Paralysis of throat and respiratory muscles are most dangerous.

5. Bedboards may be helpful.

6. If no other methods are available, be prepared to use artificial respiration, with teams for relief, if paralysis of respiratory muscles develop.

7. Paralysis of throat muscles may require intravenous administration of dextrose and saline solution.

8. Radio for instructions if necessary. (See sample dispatch.)

9. Get to a medical officer as quickly as possible.

Spinal Meningitis (Cerebrospinal Fever)

Cause.—By infection of the meninges with Neisseria intracellularis. Occurs at times in epidemic proportions, especially in densely populated areas, usually in the winter and spring months. It is spread by droplet spray from nose and mouth. Carriers may be found at all times, especially during epidemics. It is highly contagious.

Symptoms.—Severe headache periods, projectile vomiting, high fever, rapidly developing confusion, delirium, coma and high WBC. Urinalysis will usually show albumin within 24 to 48 hours, with casts. In the early stages, moderate to severe pain will be caused when the head is raised from a pillow and moved as far forward as possible, the legs raised from the hip will usually cause pain in the head, neck, and back.

Treatment.—1. Isolate if possible. Isolate mess gear and linens. Disinfect all excreta. Wear mask when attending patient. Wash hands thoroughly each time.

2. If vomiting prevents intake of fluids, intravenous solution of 5 percent Dextrose and normal saline solution should be instituted.

3. If oral medication is tolerated sulfadiazine, 6 to 8 tablets (½ gram) initially followed by two tablets every 4 hours.

4. If sulfadiazine is not available or not tolerated orally, penicillin 50,000 units every 3 hours for 2 days.

5. Light sedatives to help relieve pain and aid rest—phenobarbital, ½ grain tid., or pentobarbital sodium, ½ grain tid. Do not give morphine.

6. Catheterization and enemas may be necessary.

7. Get under the care of a medical officer as soon as possible.

NOTE.—If a case breaks out on board ship it is advisable that all personnel be given 2 to 3 grams of sulfadiazine daily for 2 or 3 days, or until a medical officer's advice is available.

ACUTE ABDOMINAL EMERGENCIES

Appendicitis

Cause.—An inflammatory process which is probably brought about by a stopping up of the lumen of the appendix with fecal material.

Symptoms.—Generalized abdominal pain which later localizes in the right lower quadrant. Nausea and vomiting. Rebound tenderness. Oftentimes a desire to defecate without being able to do so. Slight elevation of temperature. Elevation of WBC to over 10,000.

Treatment.—(If it is impossible to get the patient to a surgeon, the following conservative treatment is recommended.)

1. Bed rest in preferably the semisitting position.
2. Nothing by mouth.
3. Insert Levin tube into stomach and attach to Wangensteen suction apparatus.
4. Absolutely no laxative.
5. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.
6. Morphine, 1/4 grain for relief of pain.
7. Ice cap to abdomen if it makes the patient more comfortable.
8. If vomiting persists and the patient shows signs of dehydration, intravenous fluids of 5 percent dextrose in isotonic saline 1,000 cc. and 5 or 10 percent dextrose in distilled water 2,000 cc. daily should be given intravenously.

NOTE.—Never give morphine or penicillin if the patient is to be seen by a doctor within 3 to 4 hours time.

Acute Gallbladder Disease

Cause.—Manifestations primarily occur due to the presence of stones or infection of the gall bladder. The process that brings this about is often attributed to sluggishness of the gallbladder and a concentration of bile.

Symptoms.—May have a sudden onset or be gradual, depending upon the existing causes and their severity. Colicky pain and tenderness in the upper right quadrant, accompanied by some muscle spasm. Referred pain to right shoulder. Distress and general feeling of fullness, particularly after eating. If infection is present, toxic manifestations, such as fever, will arise.

Treatment.—1. Hospitalize as soon as possible.

2. Measures that may be instituted before hand:
   a. Put to bed in semi-Fowler's position.
   b. Give morphine, 1/6 to 1/4 grain, subcutaneously.
   c. Avoid all fatty foods in the diet. (See chapter on diets.)

Hemorrhoids (Piles)

Cause.—Hemorrhoids are usually produced either by pressure on or by an obstruction of the veins of the rectum, thus giving rise to either internal or external hemorrhoids.

Symptoms.—Internal hemorrhoids occur within the anal canal and are not visible unless they protrude, following straining. At such a time they appear outside the anus in the form of strawberry-colored masses. External hemorrhoids are covered with skin and if thrombosed take on a bluish appearance and are very tender. Pain, itching, bleeding at stool, and protrusion when straining are the usual signs and symptoms.

Treatment.—1. Surgery may become necessary. For much discomfort, a consultation is advisable.

2. Sitz baths three times a day.
3. Mild cathartics to avoid constipation.
4. High roughage diet.
5. Nupercainal ointment to the anus may give relief.

Hernia

Definition.—The protrusion of any one of the body organs from its normal position. The most common type of hernia observed among military personnel is the inguinal hernia, meaning that a loop of the intestines has slipped through the inguinal canal and appears in the groin or scrotum.

Cause.—(Inguinal) congenital and hereditary weaknesses play a large part. Injury, strain, such as lifting, or continued coughing are some of the exciting causes.

Symptoms.—The reducible hernia: Dragging sensation in the abdomen and pain of a burning or

prickling nature. Upon examination a soft mass will be noticeable in the groin or scrotum. An impulse can usually be felt by having the patient in the standing position, placing the hand over the inguinal region and asking the patient to cough. The mass usually disappears when the patient lies down.

The incarcerated hernia: The bowel becomes stuck in the hernial sac; the mass will not disappear when the patient lies down. The mass is tender and painful. Nausea and vomiting. The more severe the pain, nausea, and vomiting, the more acute the emergency.

Treatment.—1. The reducible hernia: This is not an emergency. See that the patient is given light duty and transfer him to a hospital as soon as it is convenient. Give scrotal support.

2. The incarcerated hernia:

a. This is a surgical emergency. Transfer to a hospital at once.

b. If hospitalization will be delayed longer than 6 hours:

(1) Nothing by mouth.

(2) Morphine sulfate, ¼ grain, for pain whenever necessary.

(3) Shock position.

(4) Do not exert pressure on the mass.

(5) For continued delay of transfer, insert Levin tube, attach to Wangensteen suction, and give 3,000 cc. fluids intravenously daily (1,000 cc. 5 percent dextrose in isotonic saline, 2,000 cc. of 5 or 10 percent dextrose in water), penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.

Intestinal Obstruction

Cause.—Causes are many. The most common are listed: Mechanical—Any mass, constriction, adhesion, or kink in the intestinal tract that prohibits the flow of the intestinal contents. Paralytic—A reflex that sometimes accompanies abdominal operations or injuries. It may even be associated with severe infectious diseases, such as meningitis or pneumonia. Intestinal activity may be reduced to the point that it is almost completely stopped. Vascular—A segment of the bowel is deprived of blood supply due to a thrombosis in one of the mesenteric vessels. As a result, activity in the affected bowel loop is stopped and the flow of intestinal contents is obstructed.

Symptoms.—Vary according to the cause. The following are classical in the mechanical type of obstruction: Pain—Intermittent, colicky in nature, rises to a peak, and then stops suddenly. May or may not be generalized abdominal pain. Vomiting—May be projectile; stomach contents are seen first; later, intestinal materials of fecal-odor. Retching is usually present. Immediately after onset of symptoms, the patient may have several stools, sometimes of a diarrheal nature. After the distal end of the tract is emptied, constipation ensues. Abdominal distention. The patient's face is drawn, pulse is fast, often thready, and skin is cold and clammy. He looks and is violently ill. Dehydration follows quickly. Peristaltic sounds are high pitched and can often be heard without the aid of a stethoscope.

Treatment.—This is a grave surgical emergency. Measures that may be instituted if hospitalization is delayed are:

1. Morphine sulfate, ¼ grain q 4 h.
2. Keep in semi-Fowler's position.
3. Nothing by mouth. Insert a Levin tube into the stomach and attach to a Wangensteen suction.
4. Penicillin G 100,000 units intramuscularly q 3 h.
5. Keep a record of all output and give patient intravenous fluids including 1,000 cc. of isotonic saline in dextrose 5 to 10 percent. In addition, 5 or 10 percent dextrose and also plasma should be given to combat dehydration and shock and to help meet caloric requirements of the body. Amino acids are also indicated if they are available.

Paronychia ("Run Arounds") (Felon)

Cause.—Pyogenic infections around a fingernail generally following tearing or cutting of the cuticle.

Symptoms.—Redness and tenderness laterally to or completely around the fingernail. Accumulation of pus.

Treatment.—1. Hot 4 percent boric acid soaks for 15 minutes, four times a day.

2. Sulfadiazine, 15 grains every 4 hours if the condition appears acute. Be sure to force fluids.

3. If incision and drainage appear to be necessary, the patient should be referred to a medical officer. **Incision on any part of the hand should never be performed by anyone except a surgeon.**

Perforated Peptic Ulcer

Cause.—(See "Peptic ulcer.") The ulceration of the stomach or duodenum proceeds to such an extent that it goes completely through the musculature. An ulcer history may or may not precede this occurrence.

Symptoms.—Pain—sudden, excruciating, burning pain, generally on the right side, created by stomach juices flowing into the peritoneal cavity. The abdominal muscles quickly become fixed and are boardlike. The patient is drenched with perspiration, his breathing is very shallow, he moans deeply, and he lies motionless. Shock follows quickly. The temperature at first is subnormal; then it will rise. Pulse and blood pressure may be normal at first; then it will change to fit the picture of shock.

Treatment.—A grave surgical emergency. Measures that may be instituted before surgery are:

1. Morphine sulfate, 1/4 grain, subcutaneously q 4 h.

2. Nothing by mouth. Insert a Levin tube into the stomach and attach to a Wangensteen suction. If suction apparatus cannot be set up, keep aspirating stomach contents with large syringe.

3. Complete rest in semi-Fowler's position.

4. Intravenous 5- or 10-percent dextrose in isotonic saline 1,000 cc. Over the 24-hour period 2,000 cc. additional fluids in the form of 5- or 10-percent dextrose in distilled water may be given.

5. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.

Pilonidal Cysts

Definition.—A congenital cyst found at the base of the spine.

Cause.—Believed to be formed during embryonic life from cells of hair and glandular tissues.

Symptoms.—May be unnoticed until a sinus forms and drainage occurs. The sinus is generally in midline between the coccyx and the anus. Drainage and oftentimes infection, occur frequently in connection with repeated jolting and bruising of the coccygeal area.

Treatment.—1. Hospitalization should be granted for drainage or excision.

2. Hot wet packs or Sitz baths three or four times a day may be helpful in relieving pain and congestion.

DISEASES OF THE SKIN

General Points To Remember in Treatment of Eczematous Skin Conditions

(This group includes poison ivy, nummular eczema, fungus infections, chronic vesicular eruptions of hands and feet, contact dermatitis, etc.)

1. Do not overtreat. Medications which cause a burning sensation or increased itching are to be avoided.

2. In general, treat according to the appearance of the lesions.

Acute dermatosis (redness, weeping, blisters, swelling, and crusting). Cool wet dressings are indicated. Boric acid solution 2-percent, Burrow's solution 1:20, potassium permanganate 1:10,000, or normal salt solution may be used as a soak or as wet dressing (dressings must be kept wet with solution) continuously or intermittently, depending upon acuteness of eruptions and patient's distress.

Subacute dermatosis (redness without weeping and blisters; scaling may be present). Calamine lotion or calamine liniment to which may be added 1/2-percent phenol is best. If scaling is present, mild ointments or pastes may be used—boric acid ointment, zinc oxide ointment, or zinc oxide paste.

Chronic dermatosis (little redness, much scaling, leathery thickening of the skin). Here ointments are indicated—boric acid ointment, zinc oxide ointment, coal tar ointment 1 to 5 percent, Whitfield's ointment 1/4 or 1/2 percent, or vioform ointment 3 percent.

Widespread eruptions are best treated with lotions or liniments.

3. Pyribenzamine, 50 mg., or benadryl, 50 mg., four times a day may be given by mouth for itching.

4. Do not use penicillin or sulfa preparations locally as a severe reaction may result due to an allergy being present. If the skin disease is due to infection, these drugs are more effective when given systemically.

Acne Vulgaris

Cause.—Usually appears at puberty. The presence of acne has been attributed to an unbalance of the sex hormones. Other factors, such as poor hygiene and diet, play a part.

Symptoms.—Papules, pustules, and/or cysts on the face, and oftentimes the shoulders, chest, and back. Presence of blackheads. Oiliness of the skin and scalp.

Treatment.—1. Scrub the affected areas three to six times daily with soap and warm water. This is particularly important at bedtime.

2. A sulfur lotion or the medication prescribed by a medical officer should be applied nightly.

3. The scalp must be kept clean by washing twice a week.

4. The lesions should not be picked or squeezed. Blackheads may be removed several times a week with a blackhead extractor.

5. The following foods should be avoided: fats, cheese, nuts, chocolate, pastries, alcohol, seafood, and ice cream.

6. Adequate sleep, 8 hours a day.

7. Any systemic conditions, such as infections, bad teeth, constipation, should be corrected

8. The patient should avoid excessive heat and exposure to grease and oils. Ointments and creams should not be used for shaving or as a part of the treatment.

9. Sunbathing or ultraviolet lamp treatments in erythema doses are both of benefit.

10. The patient must be warned against becoming impatient. The treatment must be continued over a long period of time, and resistant cases should be referred for consultation.

11. The following lotion will be satisfactory for the average patient:

Resorcin 3.6 gm.
Precipitated sulfur 9.6 gm.
Zinc oxide 15.0 gm.
Glycerine 12.0 gm.
Alcohol 50 percent q. s. 120 cc.

Dermatophytosis (Fungus Infections)

There are a number of fungus infections of the skin and hair, but the two most common types are tinea cruris (jock itch) and tinea pedis (athlete's foot).

Cause.—A fungus which grows in the most superficial layer of the skin and can be demonstrated under the microscope.

Tinea Cruris (Jock Itch)

Symptoms.—Area of redness in the groin which may be weeping or scaling and is outlined by a border which is raised and shows small blisters.

Treatment.—1. If acute, put the patient to bed and use only wet dressings.

2. When subacute, apply fungicidal powder night and day.

3. When chronic, apply fungicidal powder during the day and fungicidal compound ointment at night.

4. Treat the feet because they are usually the focus.

Tinea Pedis (Athlete's Foot)

Symptoms.—Skin eruption involving both feet and invariably the skin beneath and between the toes. Other areas of the foot may also be involved in addition to the toes. If acute, will show blisters, weeping redness, and sometimes secondary infection. If chronic, will show scaling and cracking about the toes and other involved areas.

Treatment.—1. If acute, use potassium permanganate 1 : 10,000 as wet dressings or soaks and put the patient at rest.

2. When subacute, continue soaks three or four times a day and use fungicidal powder between soaks.

3. When chronic, use fungicidal ointment nightly and fungicidal powder during the day.

NOTE.—Vesicular, weeping, and scaling eruptions of the feet which do not involve the toes, webs, and folds are usually not fungus infections. Vesicular, weeping, and scaling eruptions which involve both hands are usually not fungus infections.

Pediculosis

Cause.—By lice and is most frequently observed in parts of the body covered with hair.

Pediculosis Capitis

Symptoms.—Itching of the scalp. Presence of nits (eggs), especially behind the ears. The louse can be observed in the hair. A skin eruption may be present along the hair line of the neck.

Treatment.—1. Apply 10 percent DDT powder to the hair and scalp thickly and allow it to remain for 24 hours. Cover head with tight-fitting cap or bandage.

2. Shampoo the hair thoroughly.
3. Repeat the above treatment on the fourth and eighth day after the first treatment.

Pediculosis Pubis

Symptoms.—Intense and persistent itching of the pubic area and oftentimes the axillae. Presence of nits on hair and presence of the louse. Irritation of the skin can usually be noted in the affected area. One may also find nits and lice in eyebrows and/or eyelashes.

Treatment.—1. All affected areas must be treated to prevent recurrence.

2. Apply 10 percent DDT powder. After 24 hours, the person should bathe, being sure to produce a thick lather. Repeat the treatment as above in four and eight days.

3. For treatment of the eyes and eyelashes, remove nits and lice very carefully with a small forceps and apply 1 percent mercury ophthalmic ointment or ½ percent ammoniated mercury ointment.

Prickly Heat or Heat Rash

Cause.—Excessive sweating as a result of exposure to heat.

Symptoms.—Red papules on covered portions of the body. Marked itching.

Treatment.—1. Lightweight clothing should be worn.

2. Avoid soap to involved areas of skin and clean these areas with starch water daily.
3. To relieve itching, patient may use a dusting powder or calamine lotion with 2 percent resorcin.
4. Sunbaths are often helpful.
5. Severe cases should be removed from duty until cleared.

Scabies (The Itch)

Cause.—Scabies mite. History of direct contact with another infected person or of other members of the family itching.

Symptoms.—Presence of small zigzag tracks (burrows) in the form of elevated pathways with vesicles at one end. These are best seen between the fingers and on the wrists. Skin lesions are commonly found between fingers, on wrists, above the elbows, about the axillary folds, about the umbilicus, on the genitalia, and on the buttocks. The face, scalp, legs, and feet are rarely involved except in infants. Itching is most severe at night.

Treatment.—1. Attempt to find all contacts and treat.

2. Instruct the patient to take a hot shower, using a thick lather of soap.
3. Apply Crotamiton (Eurax) to the entire body from the neck down to the ankles, being sure to include arms, forearms, and hands.
4. Allow the patient to wear clean pajamas; isolate and 24 hours later reapply the Crotamiton to the entire body (no bath).
5. Twenty-four hours after the second application, the patient should take a hot shower and then put on clean clothing.
6. All clothing he has previously worn must be laundered or dry cleaned. This also applies to bedding.
7. Another formula that may be used in the same manner as the Crotamiton is Kwell.

THE PYODERMAS

Skin conditions caused by the Streptococcus or Staphylococcus, separately or together.

Folliculitis.—Inflammation of the hair follicles.

Symptoms.—Pustules around the hair follicle, most often seen on the face. The lesions may be single or grouped, and if on the face, often appear first about the upper lip. Most often found among those who work with grease, oil, tar, or irritating chemicals.

Treatment.—1. Cleanliness of the skin is foremost in importance. The patient should wash the area thoroughly each morning; then he should manually pull out the affected hairs.

2. Follow with hot wet dressing for at least 15 minutes.
3. Apply an ointment, such as 3 to 5 percent ammoniated mercury or 3 percent vioform, and then lather the area thoroughly and shave. After shaving, reapply the ointment.
4. The ointment should be applied several more times during the day and before going to bed.
5. The razor should be sterilized after shaving and a clean blade used daily.
6. Consultation should be requested if no improvement occurs.

Impetigo Contagiosa

Symptoms.—Appearance of honey colored crusted lesions that are sharply defined. There may be several lesions or only one, but spreading usually is rapid. Generally found on the face or neck. Itching may or may not be present.

Treatment.—1. Exercise care in preventing a spread to others. Equipment for washing and bathing should be held separate until the lesions are cured.

2. The crust must be removed completely with boric acid compresses, hydrogen peroxide, or soap and water three times a day.

3. After the crust is completely removed, apply 5 percent ammoniated mercury or 3 percent vioform ointment and rub rather vigorously into the area.

4. If the lesions are in the bearded area, the patient should shave daily, using a clean blade and a razor which has been sterilized by boiling.

NOTE.—For treatment of furuncles—carbuncles refer to "Wounds."

NEUROLOGICAL CONDITIONS

Convulsions

Cause.—Convulsive attacks are not considered to be a disease but rather symptoms of a disturbance of the central nervous system. They range from petit mal attacks which are very brief and fleeting and do not cause unconsciousness of the patient to grand mal seizures in which there is complete loss of consciousness.

Symptoms.—Grand mal: The patient may have a warning "aura." This warning can appear in any form, such as a bright flash of light or a peculiar feeling in the epigastrium. He may utter a cry. He then falls to the deck, unconscious and rigid. He may be apneic and cyanotic. This is the "tonic" phase of the seizure. Coarse tremors quickly follow that generally involve the entire body. This is the "clonic" phase of the seizure. The patient may froth at the mouth, bite his tongue, and become incontinent. Gradually consciousness returns and the patient appears confused and disoriented. Drowsiness and a desire to sleep follow; the patient may have a headache.

Treatment.—Hospitalization is indicated; however, as a general rule, this is not an emergency unless the patient has repeated attacks at close intervals.

1. Have the person removed to sick bay where he can be observed.

2. Bed rest following an attack usually is not required but should be granted if deemed necessary.

3. During the seizure:

a. Keep the patient from hurting himself.

b. Turn him on his side so that mucus can flow from mouth and throat.

c. Place tongue depressors, spoon handle, or some other firm object between the teeth to prevent biting of the tongue.

d. Do not restrain; only protect.

4. After the convulsion:

a. Give phenobarbital, ¼ to ½ grain, three times a day.

b. Make sure that he has a lower bunk; better still, allow him to sleep on a matress that has been placed on the deck.

c. Record accurately all that was observed—the manner in which the convulsion spread over the body, approximately how long it lasted, and any accompanying episodes that were witnessed. Make a note of any situations, such as excesses of caffeine, tobacco, or emotional tension, that might have a bearing on the seizure.

5. If a medical officer is not available, a person who has convulsions in rapid succession may be given sodium amytal, 3 to 7½ grains, intravenously and very slowly to help prevent further attacks.

Headaches

Cause and symptoms.—Tension due to emotional conflict usually involves the entire cranium. Sinusitis—involving the frontal and maxillary areas and oftentimes accompanying a cold. Eye strain—reading in poor light; need of glasses. High blood pressure—due to great tension of the blood vessels. Any toxic condition such as may be brought about by viruses, bacteria, or constipation. Increased intracranial pressure—brought about by any space-taking lesion in the brain. Migraine—thought to be a circulatory disturbance in the brain that causes intense pain that is usually unilateral, nausea, vomiting, followed by fatigue, and oftentimes depression.

Treatment.—1. Attempt to determine the cause.

2. Mild analgesics, such as aspirin, 10 grains; in severe cases, such as sinnsitis, codeine, ½ grain may be given with aspirin.

3. Persistent headaches that are accompanied by systemic involvement should be referred to a medical officer at the first opportunity.

Intracranial Injuries

Foreword.—Intracranial injuries can occur in varying degrees. The damage done to the brain tissue is the serious issue. Regardless of the type of injury, be it a concussion, hemorrhage, or fracture, certain observations should be made and treatments instituted.

Symptoms.—Develop in relation to the severity of the condition. Blood pressure—Systolic pressure rises. Diastolic rises also but not as fast; therefore an increase occurs in pulse pressure. The pulse rate slows down, oftentimes to 60 or below. It is generally a heavy, full pulse. Respirations are slower; in severe conditions they are of the Cheyne-Stokes type. The temperature generally rises. The level of consciousness may vary and should be observed. If the patient is conscious he complains of headache which is aggravated by bending forward, by coughing, by straining at stool, etc. Pupils may be unequal in size; sometimes there is unusual eye movement. Grimacing, paralysis, and convulsive movements should be watched for. Reflexes are generally increased on the side opposite to the one affected. Observe patient for scalp lacerations, contusions, or leaking of fluid, especially from nose or ears.

Treatment (this holds true for the unconscious patient in general).—1. Keep the patient's airway open. Keep the mouth, nose, and throat free of mucus, blood, and vomitus by suction. A large syringe and small rubber catheter may be used. If you are sure the patient has no spinal injury, turn him on his side.

2. Stop any gross bleeding; use pressure bandages or hemostats if necessary.

3. Take the blood pressure, temperature, pulse, and respirations and record.

4. Catheterize the patient and save the specimen. Strap the catheter in place. Keep a record of the output.

5. Observe the following and record:

a. Note any eye changes, dilation of pupils, unusual eye movement.

b. Note any convulsive movements, facial grimacing, jerking.

c. Note the level of consciousness; that is, whether the patient is conscious, stuporous, irrational, combative, comatose.

d. Look for paralysis of the limbs. Determine by pinching or pricking with pin.

6. Start intravenous fluids of 5 percent dextrose in water. Fluids should be restricted somewhat, but dehydration must be avoided—1,500 cc. daily is about average intake.

7. If possible, do a urinalysis (look for sugar and blood particularly) and CBC.

8. Give tetanus toxoid if injury is present.

9. Shave widely around any lacerations and cleanse thoroughly by irrigating with sterile normal saline under low pressure and apply dry sterile dressing.

10. Temperature rectally every hour. If the temperature reaches 103° F. or over, remove clothing and give continuous body sponges with alcohol.

11. Continue suctioning throat frequently. If spinal fluid is leaking from the nose, do not suction the nose. (The patient should not be allowed to blow his nose if he is conscious.)

12. Turn from side to side every hour.

13. For uncontrollable restlessness, give paraldehyde 4 cc. deep into the gluteal muscle whenever necessary. **Never give narcotics.**

14. Continue taking and recording pulse, respirations, and blood pressure every 15 to 30 minutes.

15. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours if the patient has lacerations and fractures.

Spinal Cord Injuries

Foreword.—Spinal cord injuries are usually caused by fracture of the vertebral column, gunshot wounds, or stabs. In any injury of this type proper care is of the most importance. Observing the patient for injury to the viscera must not be overlooked. One who presents the picture of shock usually has a deeper, accompanying injury.

Symptoms.—Aside from the presence of a wound one should note whether the patient can

move one or both feet. Note whether he appreciates painful stimuli, such as a pin prick to the lower extremities. Look for gross injury to the spine.

Treatment.—1. If shock is present that must be treated first.

2. Do not move the patient until you have a sufficient number of men available.

3. Do not twist the body or allow it to bend; keep the head aligned with the body.

4. A fracture board should be improvised and slipped under the mattress of the bunk.

5. The patient may have to be catheterized. Scrupulous technique must be used; tape the catheter in place.

6. Good nursing care is of great importance. Decubitus ulcers form rapidly.

7. Keep the possibility of meningitis in mind. Start penicillin (crystalline G) 100,000 units q 3 h.

8. Transfer to a hospital as quickly as possible.

9. See fracture of spine, First Aid and Emergency procedures.

GENITO-URINARY CONDITIONS

(The Kidneys and Ureters)

Renal Colic (Renal Calculus)

Cause.—Generally brought about by stones but may occur due to any substance that blocks the flow of urine; e. g., blood clots.

Symptoms.—Pain—onset is usually sudden. Begins in loin of the affected side; and as the stone descends in the ureter, the pain begins to radiate downward and forward into the thigh and testicles or sometimes down the back of the thigh. Nausea and vomiting often present; also profuse perspiration. Rigidity of the muscles in the loin of the affected side. Oftentimes abdominal distention occurs. Urinary findings are red blood cells, albumin, and white blood cells if infection is also present. Obtain past history of such attacks, operations performed.

Treatment.—1. Put to bed; give morphine sulfate, $\frac{1}{6}$ to $\frac{1}{4}$ grain, for relief of pain. Atropine, $\frac{1}{150}$ grain, may also be given to relieve spasm.

2. Nothing by mouth until vomiting subsides.

3. Prevent dehydration. Give intravenous fluids of 5 percent dextrose in water if necessary.

4. Check the urinary output conscientiously. Strain all urine and watch for stones.

5. For distention use rectal tube, heat to abdomen, enemas.

6. Transfer the patient to a hospital as soon as possible.

Pyelonephritis

Cause.—Infection of the renal pelvis and parenchyma. B. coli is the most common offender.

Symptoms.—Sudden onset with chills and fever. Dull aching pain in the kidney involved; also tenderness. Frequency, urgency, and discomfort on urination. Urinalysis shows pus, albumin, and possibly red blood cells. Abdominal distention is not uncommon. White blood count may be elevated.

Treatment.—1. Put to bed.

2. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours. In severe cases give sulfadiazine and soda bicarbonate, 15 grains of each every 4 hours in addition to penicillin. When giving sulfa drugs, force fluids.

3. Diet as tolerated.

4. Mild sedation if needed.

5. For abdominal distention, rectal tube, heat to the abdomen, enema.

Kidney Injury

Cause.—History of injury either due to a fall or a blow in the back in the region of the lower ribs.

Symptoms.—Pain in the loin. Blood in the urine, oftentimes in the form of clots (thread-like in shape, formed in the ureter). The loin should be palpated. If a growing, tender mass is felt, it is generally due to an escape of blood into the area surrounding the kidney. Shock and signs of hemorrhage in the more severe cases.

Treatment.—1. For shock, start plasma and give morphine sulfate subcutaneously for pain.

2. Start penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.

3. Observe the patient closely. If injury is not severe, the following picture usually presents itself in 12 to 24 hours:

a. Temperature does not rise.
b. Discomfort does not increase.
c. No further swelling in the loin is noted.
d. Some blood may still be in the urine.
e. Blood pressure and pulse remain or become normal.

4. In severe injuries, surgical treatment is indicated. The following picture usually presents itself in 12 to 24 hours:

a. Increase of pain.

b. Discoloration of the flank; enlarging mass.

c. Evidence of extravasation of urine into the flank.

d. Continued bloody urine with clots.

e. Appearance of toxic signs, such as rise in temperature.

f. Signs of blood loss, such as shock with falling blood pressure, rapid weak pulse, palor, cold clammy skin.

LOWER URINARY TRACT (BLADDER, URETHRA, AND GENITALIA)

Bladder Injuries

Cause.—Bone spicule or foreign body, such as shrapnel or a bullet, enters bladder. Frank rupture due to crushing injuries; oftentimes found to accompany fracture of the pelvis.

Contributing causes.—A full or overly distended bladder. Numbing from excessive intake of alcohol which in turn permits an overly distended bladder.

Symptoms.—A desire to urinate almost constantly without relief. Hematuria. Failure to obtain clear urine via catheter, usually only a few cubic centimeters of bloody urine. Pain in lower abdomen. Extravasation of urine into the surrounding tissues, which rapidly develops into infection.

Treatment.—1. A grave emergency. Requires surgical treatment within 24 hours.

2. Treat the shock; relieve the pain.

3. Put a retention catheter in place if possible.

4. Start penicillin (crystalline G) 100,000 units intramuscularly.

Injuries to the External Genitalia (Straddle Injuries, Contusion of the Genitalia)

Cause.—History of blow or fall, resulting in direct injury to the genitalia.

Symptoms.—(Will vary in relation to severity of the injury). Shock and intense pain; the patient is usually writhing. Hemorrhage may occur; hematuria. A desire to void without being able to do so. A hematoma often develops rapidly. Fever and infection may develop later.

Treatment.—1. Morphine sulfate, 1/6 to 1/4 grain, for pain.

2. Immediately attempt to pass a catheter. If successful, secure by means of adhesive strips.

3. Treat the shock.

4. Begin penicillin (crystalline G) 100,000 units intramuscularly.

5. Ice to the injured part, particularly in the case of contusion.

6. Elevate the genitalia. This may be accomplished by a thickly folded towel, or by use of adhesive bridge from thigh to thigh.

NOTE.—In any severe injury to the urethra or genitalia, when it becomes impossible to insert a catheter, bladder distention must not be allowed to progress to the point that the bladder will rupture. If medical help does not become available within 10 to 12 hours and the bladder is rising into the abdominal cavity, the following may then be done as an emergency measure:

1. In midline, about 2 inches above the symphysis pubis, shave, cleanse, and apply an antiseptic.

2. Infiltrate the area with 1/2 or 1 percent procaine. (See "Anesthesia.")

3. Insert a No. 16 or 17 needle and allow enough urine to flow out to give the patient relief and diminish the intra-bladder pressure.

4. Do not empty the bladder completely. In a greatly distended bladder, not more than 500 to 600 cc. should be allowed to flow out.

5. After release of urine remove the needle and apply a dry, sterile dressing to the area.

Epididymitis

Cause.—Infection, often of non venereal origin, straining, lifting with a full bladder.

Symptoms.—Pain, tenderness, and a slightly irregular mass at the testicle, pain in groin. Fever, nausea, malaise. Inflammation of the scrotal wall and skin. Careful palpation will reveal an area of maximum tenderness and induration behind the testicle in the epididymis.

Treatment.—1. Elevation of the scrotum.

2. Hot or cold compresses continuously (use whichever gives patient most relief).

3. Analgesics for pain.

4. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours or streptomycin, 0.5 gm., q 6 h.
5. Hospitalize.

Phimosis

Cause.—May be congenital or acquired. In the latter situation, inflammation, unclean habits, or trauma may be predisposing factors.

Symptoms.—Inability to retract the prepuce over the glans. The orifice is generally small in relation to the size of the glans.

Treatment in presence of active inflammation.—1. Hot saline soaks.
2. Cleansing under foreskin with irrigations of a mild antiseptic.
3. Hospitalize for circumcision.

Paraphimosis

Cause.—A certain degree of phimosis and prolonged retraction of this tight foreskin, held in the sulcus behind the glans penis. The prepuce margin forms a constriction there, which strangulates as edema develops.

Symptoms.—Swelling, edema, and discoloration on the glans develop rather quickly and are accompanied by considerable pain.

Treatment.—1. Elevation—ice bag in early stage.
2. Manual manipulation (to reduce swelling by direct pressure and draw forward the constricting foreskin from behind the glans).
3. If the condition is too far advanced, cut this constricting portion (novocaine 1 percent locally infiltrated).
4. Circumcision at later date when reaction subsides.

Balanitis

Cause.—Due to retention of irritating materials under the prepuce, thus bringing about an inflammation of the glans. Uncleanliness is the outstanding factor, plus a redundant prepuce.

Symptoms.—Glans and prepuce red and moist. Swelling and pain. Itching sensation. Foul-smelling secretions.

Treatment in active inflammation.—1. Hot saline soaks or potassium permanganate 1:10000.
2. Cleansing irrigations under foreskin.
3. Circumcision when active inflammation subsides.
4. If unable to cleanse under prepuce and inflammation progresses or fails to respond, make a dorsal slit and expose the glans to permit effective local cleansing and soaks.
5. Antibiotics if associated with severe inflammation and fever.

EYE, EAR, NOSE, AND THROAT

The Eye

General points to keep in mind concerning eye examinations.—1. Before treating a new patient's eye, always determine his approximate visual acuity and record same. If an eye chart is not available, one should be improvised.
2. A good light must be at hand.
3. A magnifying glass or Beebe Binocular Loupe should be used if available.
4. The patient should be seated with his head braced.
5. To examine the eye, have the patient look up while the lower lid is being pulled down. Have the patient look down; pull the upper lid straight out by placing the thumb under the upper eyelashes and the index finger on top of the lid. Evert the upper lid.
6. When using any type of instrument on the eye, such as an applicator or medicine dropper, the operator must rest his hand on the patient's head.
7. For the patient who is unable to cooperate, instill a drop of one-half or 1 percent pontocaine into the eye before continuing.
8. Any time the cornea is affected, consider the condition serious and send the patient to a doctor.

EYE CONDITIONS

Conjunctivitis

Cause.—Bacterial infection of the conjunctiva.

Symptoms.—Redness of the sclera. Pus present in the eye. Burning sensation.

Treatment.—1. To gain the patient's cooperation, put 1 drop of one-half or 1 percent pontocaine into the eye.

2. Four times daily, irrigate the eye with 2 percent boric acid solution and apply hot compresses; then apply an antibiotic ointment.

3. The patient should wear a patch over the eye and be seen by a doctor as soon as possible.

Iritis

Cause.—Bacterial infection of the iris.

Symptoms.—Redness around and over the iris. The eye waters. Usually intense pain.

Treatment.—1. Pontocaine one-half or one percent (1 drop in the eye) or 1 percent atropine ointment to the eye.

2. Put patch over the eye and send to the hospital at once.

Styes

Cause.—A bacterial infection of the glands of the eyelids.

Symptoms.—Localized swelling and redness of the eyelid.

Treatment.—1. Apply hot compresses every 3 hours.

2. When pus appears and the stye becomes fluctuant, gentle pressure may be used to release the exudate.

3. Irrigate the eye with 2 percent boric acid solution.

Flash Burns

Symptoms.—Entire eye is red. Symptoms may not develop until a day or two after exposure.

Treatment.—1. Irrigate the eye with warm normal saline, apply atropine ointment or butyn, and cover.

2. If there is visual loss, the patient should be seen by a doctor.

THE EAR

External Ear Infection

Cause.—Usually bacteria resulting in cellulitis, sometimes fungus.

Symptoms.—At first, itching, and feeling of fullness in the ear, then pain. The patient experiences acute pain when pressure is exerted on the tragus, or the auricle of the ear is moved. A discharge may be present and is normally of a serious nature. When one attempts to observe the ear drum with an otoscope, the canal is often found to be closed due to swelling.

Treatment.—1. Reduce the swelling by soaking a narrow strip (about one-fourth inch wide) of fine mesh gauze in warm 5 percent Burrow's solution and insert this into the ear. Four times daily resaturate the gauze wick by putting several drops of warm Burrow's solution into the ear. Reinsert a fresh wick daily. Four percent boric acid solution may be used if Burrow's is not available.

2. Give penicillin (crystalline G) 50,000 units intramuscularly every 3 hours if the patient has fever.

3. Aspirin, 10 grains, and codeine, ½ grain, for pain.

4. After swelling subsides, keep the ear clean and dry by using cotton applicators.

5. Warn the patient against swimming. Tell him that while he is taking a shower he should put cotton plugs in his ears.

6. Keeping the ear clean and dry is the most beneficial treatment. Avoid the use of irritating substances; e. g., alcohol, cresatin.

Otitis Media (Middle Ear Infection)

Cause.—The patient will usually give a history of a cold or sore throat. Bacteria gets into the middle ear by way of the eustachian tube.

Symptoms.—Severe earache which is not aggravated by pressing on the tragus or manipulating the auricle. Fever may be present. Upon looking at the ear drum with an otoscope, one will see that it is red and bulging. (Normally it is a silvery white color). No drainage is present unless the drum has ruptured; then pus will appear and the patient will have relief from pain.

Treatment.—1. Nose drops of neosynephrine one-fourth percent four times a day. Have the patient assume the usual position for giving nose drops; then turn his head to the affected side.

2. Warm saline gargle four times a day.

3. Warm glycerin may be dropped into the ear to help relieve the pain. This must be done only if the ear drum is intact.

4. Penicillin (crystalline G) 50,000 units every 3 hours.

5. Aspirin, 10 grains, and codeine, ½ grain, for pain.

6. When drainage is present, the ear canal must be kept clean and dry by using cotton wicks.

7. Never irrigate an ear in the presence of otitis media.

8. Force fluids.

9. A person who has had an otitis media and begins complaining of tenderness and pain behind the ear should be regarded as a mastoiditis patient and be hospitalized.

Ruptured Ear Drum (Without Infection)

Cause.—Normally results from blow to the head, diving, or blast of air, as from an explosion.

Symptoms.—Sudden, sharp pain in the ear. Bleeding from the ear. Upon observing the ear drum with an otoscope, one may see frank blood or a black area (the rupture) in a white, shiny drum.

Treatment.—1. Nothing need be done in the way of treatment except to be aware of infection developing. Then institute otitis media treatment.

2. Warn the patient against swimming. Instruct patient to put cotton in the ear while taking a shower.

3. Aspirin, 10 grains, and codeine, ½ grain, for severe pain.

Sinusitis, Acute

Cause.—Inflammation of one or more of the sinuses, usually accompanying or following a head cold.

Symptoms.—Get history of any previous attacks. The patient generally complains of headaches in the frontal or maxillary areas. He may or may not have fever. If drainage is adequate, pus will run from the nose. There may be accompanying inflammation of the ears and throat.

Treatment.—1. If fever is present the patient should be put to bed.

2. One-fourth percent neosynephrine, six drops in each nostril four times a day. Do not use nose drops indiscriminately. If a man is out of doors in the cold air, his condition will only be aggravated by shrinking the tissues. Wait until he is indoors to use drops.

3. Steam inhalations several times a day. If it is impossible to set up for steam inhalations, a hot shower is helpful. Avoid chilling afterwards.

4. Heat, such as an infra red light helps relieve congestion.

5. Aspirin, 10 grains, and codeine, ½ grain, may be given for severe headaches.

6. For fever cases penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.

THROAT

Acute Pharyngitis

Acute inflammation of the mucosa of the throat.

Cause.—Most often brought about by organisms that cause the common cold.

Symptoms.—Soreness and inflammation of the throat. The appearance of the throat will depend upon the causative agent. In acute follicular tonsillitis the gross picture will be that of white or yellowish spots of pus in the crypts of the tonsils. These are generally easily brushed off. A typical streptococcal throat is very red and swollen. A grayish membrane may be present over the tonsils. Systemic reactions: Chilliness, malaise, headache. Fever and increased pulse rate. Great difficulty in swallowing. Glandular swelling.

Treatment.—1. Isolate and put to bed. (See "Isolation technique").

2. Hot saline gargles every two hours.

3. Penicillin (crystalline G) 100,000 units intramuscularly every 3 hours.

4. Aspirin, 10 grains, as needed for relief of pain.

5. The diet may be a problem due to the patient's difficulty in swallowing. Bland foods are preferred usually. Fluids should be given freely. (Refer to the chapter on diets.)

6. Hospitalization should take place at the earliest time possible.

Laryngitis

Cause.—An inflammation of the mucous membrane of the larynx usually brought about by the organisms that cause the common cold. In recurrent cases of laryngitis without accompanying symptoms of a cold, such chronic conditions as polyps, cancer, or tuberculosis should be borne in mind. A consultation should be granted.

Symptoms.—Irritation of the throat and hoarseness. Sometimes fever.

Treatment.—1. Absolute bed rest.

2. No smoking.

3. Steam inhalations.

4. For acute conditions with fever, penicillin (crystalline G) 50,000 units intramuscularly every 3 hours.

PSYCHIATRIC DISORDERS

The Immature Personality

One who in the face of new adjustments finds himself incapable of taking responsibilities. As a result, he may react in a childish manner. (Often found in the younger age group).

Characteristics.—(Rarely do all of these exist in one person). History of overprotection at home; sometimes a broken home situation. Egocentric—finds it difficult to get along with his buddies. Under emotional strain he may go AWOL, perhaps become hostile, have temper tantrums, or become tearful. He may have complaints that are organically unfounded, such as headache, sticking pains in his chest, or gastrointestinal symptoms. Bedwetting. Sleep walking or talking. Sometimes uses suicidal gestures as an attention-getting mechanism.

Treatment.—1. A sincere attempt should be made to find out the difficulty back of this behavior by skillfully getting the patient to talk to you.

2. Your judgment, understanding, and counseling come into play in helping the patient.

3. If the above fails, a neuropsychiatric consultation may be advisable.

The Psychoneuroses

A group of mental disorders that are mild in character. They are actually substitution reactions that come into play, rather than ones that would be considered normal. Some of the reactions under this heading are:

Anxiety hysteria.—Sieges of anxiety, apprehension (sometimes accompanied by palpitation), excessive perspiration, vomiting, and diarrhea.

Conversion hysteria.—Manifested by such phenomena as sudden blindness, paralysis of one or more of the extremities, and anesthesia of a portion of the body. This again serves as a substitution to prevent gratification of certain unconscious desires.

Compulsion neuroses.—A situation in which a person feels compelled to carry out acts which he realizes are unnecessary or sometimes even irrational.

Treatment.—1. Neuropsychiatric consultations are in order if these conditions continue to interfere with the person's efficiency.

2. Avoid being critical. An understanding attitude is to be maintained at all times.

The Acute Psychoses

Symptoms.—(The following symptoms are general classifications of the various psychoses and are rarely all seen in one person.) Withdrawal from the group; uncommunicative. Delusions and hallucinations; contact with the environment is poor. Overactive, flighty, distractible, overtalkative. Deep depression, possible suicidal attempts, death wish. Ideas of persecution. Combative.

Treatment.—1. Put the patient where he cannot harm himself.

2. Do not use restraints unless absolutely necessary.

3. Get everything out of the room, including the bunk, if possible. Put the mattress on the deck.

4. If the patient is combative and a separate room is not available, put the patient to bed and use restraints. This is best accomplished by using folded sheets at the ankles, above the knees, and under the armpits. Wristlets must also be employed. If they are not available, use folded towels. Avoid restraint over the chest and abdomen.

5. Make sure that all materials with which the patient might harm himself are removed. Glass of any type, instruments, and belts are all potential means of committing suicide.

6. If feeding becomes a problem, the patient may need to be gavaged. (See chapter on nursing for proper technique).

7. The patient may need a sedative if violent. Paraldehyde is the drug of choice; average dose 4 to 10 cc. by mouth, rectally, or intramuscularly (deep).

Points to remember regarding the neuropsychiatric patient.—1. Attempt to understand yourself and your own personality so that you will not be prejudiced in the light of yourself.

2. Do not make a neuropsychiatric diagnosis. Always send the patient in for consultation or to the hospital with diagnosis undetermined.

3. Enter facts as you see them; make objective reports on the health record. Keep adequate and complete records. Subjective complaints should also be entered in quotations using patient's own words.

4. Keep all neuropsychiatric records and information confidential.

5. Never be dictatorial; aggression always produces counter aggression.

6. Vagueness and "beating around the bush" are commonly seen in persons who are attempting to bare their feelings. This vagueness stems from a feeling of pride and also a feeling of shame on the part of the patient. For this reason force or aggression of any type are worthless.

7. Develop a willingness to give these patients as much understanding as possible.

8. Treat all patients alike; show no favoritism.

9. In minor disorders, rather than hospitalizing a patient, request a neuropsychiatric consultation if you cannot assist the patient in any way.

10. Watch those who are overly elated or overly depressed much of the time. Sometimes a serious psychosis can be thwarted if observed early.

11. Never give opiates unless there is a medical or surgical reason. Paraldehyde is the drug of choice.

12. Remain calm if patient vilifies you or calls you names.

OBSTETRICS

Labor.—A long series of rhythmical contractions of the uterine wall that dilate and efface the cervix and then expel the uterine contents.

Estimated date of labor.—The estimated date of beginning of labor can be determined by counting back 3 months from the first day of the last menstrual period and adding 7 days. *For example:* If the first day of the last menstrual period was 16 May, the estimated date of beginning of labor is 23 February of the following year.

Stages of Labor

First stage.—From the time of the first contraction until the cervix is completely dilated and effaced.

Pains are irregular at first and then they become regular with shorter intervals between; they increase in quality.

A woman having her first child generally is in labor longer (about 16 to 18 hours) than one who has delivered previously.

Second stage.—From complete dilatation and effacement of the cervix through birth of the baby.

Contractions increase in rhythm and quality; they usually occur every 2 to 3 minutes and last 60 to 70 seconds.

The patient is restless and complains of pain that radiates down the thighs.

The patient bears down involuntarily.

A bloody, mucus discharge is released.

Membranes rupture and about 700 to 1,000 cc. of fluid escapes.

As the head descends, bulging of the perineum will occur with each contraction.

This stage is about 2 hours long if a woman is having her first child. For those who have had more children, it may be comparatively short.

Third stage.—From delivery of the infant through delivery of the placenta (afterbirth). This lasts about 15 to 30 minutes.

Care of the Mother

1. Signs of approaching delivery are those listed under the second stage of labor. Here their intensity is generally greatly increased.

2. Light food should be given early in labor but should be withheld during the second stage. Give fluids by mouth.

3. Early in labor, it is advisable to see that the mother receives a cleansing enema and a shower bath.

4. The perineum and anal area should be cleansed with a heavy soap solution. The perineum may be shaved. At all times, no fluid should be allowed to enter the vaginal canal. The patient should put on a clean gown.

5. The patient should be urged to void frequently. A full bladder retards labor.

6. Early in labor she may be up and about. After the membranes rupture or contractions become hard (about every 5 minutes), she should be put to bed. Then if she wishes, allow her to pull on something, such as a sheet tied to the foot of the bed on either side.

Equipment Needed

1. Freshly laundered (preferably autoclaved) towels. Select old towels and if autoclaving is

impossible, bake them in a hot oven until they turn brown or scorch them with an iron.

2. Two sterile large hemostats or Kelly clamps.
3. One sterile scissors.
4. A sterile basin or bucket to receive the afterbirth.
5. A sanitary belt for the mother or an improvised belt made of gauze bandage.
6. Kotex or improvised pads made of cotton and gauze. These should preferably be sterile.
7. Several large containers of boiled water.
8. Umbilical tape or four strips of sterile 1 inch gauze bandage about 10 inches long.
9. Clean blanket for the baby.
10. Sterile dressing (4 by 4 inches are best) and 3-inch roller bandage for dressing the cord.
11. One percent silver nitrate for the baby's eyes.

Procedure for Delivery

No two women go through labor and delivery in exactly the same manner. The information given here is of a general nature.

1. When touching the mother, make certain that your hands are scrupulously clean at all times. (Sterile gloves are advisable during actual delivery).
2. Never perform a rectal or vaginal examination.
3. The mother should assume the dorsal recumbent position during delivery.
4. Have a good light at hand if possible.
5. The head is usually born first. Place the left hand under the baby's face and be prepared to receive the body with the other hand.
6. It is advisable to wipe the baby's face as soon as it is exposed.
7. Check with your forefinger to make sure that the cord is not wrapped around the neck. If so, try to slip it over the baby's head to prevent strangulation. If this cannot be done, clamp the cord with two hemostats placed 2 inches apart, and cut the cord between them. If clamps are not available, use the umbilical tape or gauze, tie 2 inches apart with a firm tight square knot, and cut between them.
8. After birth, place the baby in the blanket, being sure not to place or put tension on the cord. Make sure the baby breathes normally and that the throat and nose are free of mucus. Snapping the soles of the baby's feet with the forefingers often brings out the welcome cry. Holding the baby up by its feet helps mucus to flow out. (Be sure to put one finger between the ankles and hold the infant over the bed.) Do not spank or swing the baby.
9. Clamp the cord with the sterile hemostats or tie with sterile tape or gauze bandage as directed in No. 7. Cut with sterile scissors between the clamps or ties.
10. Wrap the baby in warm blankets; place it on its side and proceed with care of the mother.
11. Receive the afterbirth in a sterile basin.
12. Cleanse the perineum by means of pouring sterile water over it; apply the sanitary belt and kotex (cotton and gauze pad).
13. Keep close watch on the uterus. It must remain firm or bleeding will be profuse. It should be about the size and consistency of a grapefruit and be felt just below the umbilicus. If it softens, massage by rubbing the abdomen just below the umbilicus.
14. The mother's blood pressure should be taken at 30-minute intervals (if possible) for three times after delivery.
15. Check on the uterus frequently.
16. After delivery the mother will probably want to sleep. A mild hypnotic may be given but usually is not necessary.

Important Points To Remember

1. If delivery is rapid or occurs under circumstances that are not ideal, do not attempt to prevent the birth. Instruct the patient to breathe deeply through her mouth and if at all possible to keep from bearing down. This may keep her from delivering for a short while.
2. In an absolute emergency, one needs the tape for tying the cord, a sterile scissors, and a basin to receive the placenta.
3. Never examine the patient internally.
4. Never pull the cord.
5. Watch the newborn for cyanosis and bleeding of the cord stump. The former can often be relieved by clearing any mucus from the nose and throat and by causing the baby to cry; the latter can be relieved by retying the cord.

ABORTIONS

Definition—Spontaneous, therapeutic, or criminal interruption of pregnancy before the fetus is viable, generally occurs during the first 2 months.

Symptoms.—Vaginal bleeding, often blood clots. Cramping pains in pelvic region. Backache.

Treatment.—1. Put to bed in shock position if necessary.

2. Morphine sulfate, 1/6 grain, or paregoric, 4 cc. by mouth.

3. Save all blood clots or membranous material expelled for examination by a doctor.

4. Get the patient to a doctor as quickly as possible.

ANESTHESIA

Anesthesia as it is known today requires diligent and extensive training and study. Only in times of emergency, when a qualified anesthetist is not available, should a hospital corpsman ever attempt to administer an anesthetic. The types of anesthesia considered the safest and the circumstances under which they should be given are included in the following pages. Remember always that when a person is being subjected to anesthesia, his higher centers become paralyzed and circulation, as well as respiration, is somewhat depressed. For this reason, great care must be taken to have on hand materials and equipment that can combat any untoward reaction.

Local Anesthesia

Definition.—Desensitizing of a part of the body without interfering with consciousness.

Types

Nerve block.—The injection of the anesthetic agent is made some distance from the region to be anesthetized by blocking off the sensory nerves.

Infiltration anesthesia.—The blocking of nerve endings in the region itself. Limited to area where drug is injected.

Topical anesthesia.—The application of anesthetic agent to skin or mucous membrane; e. g., cocaine is effective if applied to the mucous membrane but not when applied to the skin. Ethyl chloride will produce anesthetic effect due to refrigeration.

Anesthetic Agents

Procaine (novocaine):

Least toxic of all local anesthetic agents.

Most commonly used in one-half or 1 percent, sometimes 2 percent solutions.

Can readily be sterilized by heat.

May be prepared either with isotonic saline or distilled water.

Total dose of procaine tolerated is about 1 gram.

Cocaine (very toxic):

Is used only for topical application to mucous membranes in 4 or 5 percent solutions.

Creates tremendous shrinking of tissue as well as producing vasoconstriction within the area.

Great tendency to produce respiratory and cardiac depression.

Solution must be freshly prepared.

Heat deteriorates cocaine rapidly.

Other agents (very toxic and to be avoided):

Nupercaine.

Pontocaine.

Metycaine—can be used safely with care.

General precautions.—Remember when doing a local infiltration these toxic manifestations must be kept in mind at all times:

1. Central nervous system stimulation characterized by pallor, perspiration, tremors; and if severe, even convulsions which may be followed by death. Emotional reactions and stimulation which are due to epinephrine given may resemble early central nervous system toxic reactions. This is brought about as a direct function of the dose. Keep doses at a minimum.

2. Anaphylactoid reaction is extremely serious in that it is generally manifested by sudden death after the anesthetic agent is given. The amount of anesthetic agent used is immaterial in relation to this type of reaction. It is due to reaction of the body to the drug in an unknown way; fortunately, it is rare.

To prevent toxic manifestations, give the patient 1½ to 3 grains (100 to 200 mg.) of nembutal or seconal before injecting procaine. Ideally, the patient should receive the barbiturate about 1 to 1½ hours beforehand. If sodium amytal or sodium pentothal is available, it should be close at hand for emergency intravenous use.

Epinephrine is routinely added to procaine for the purpose of constricting the blood vessels in the area and thus prolonging the effect of the anesthetic agent. Amount used is about 5 minims of a 1:1000 solution to every ounce of procaine solution.

Do not use epinephrine when blocking the toes, fingers, or ears. It is too potent a vasoconstrictor and will cut off the blood supply in the digit and create irreversible tissue damage.

Never give a drug unless you have prepared it yourself.

Never give an anesthetic agent unless it has just been freshly prepared.

Do not inject agent into blood stream. Aspirate on the syringe frequently to make certain the needle is not in a vessel.

Remember that the route, amount, and rapidity with which a drug is given have a bearing on the toxic effects of it; i. e., central nervous system stimulation.

Check the patient's blood pressure before and after any procedures involving the use of a local anesthetic.

Do not use more drug than is absolutely necessary.

Equipment.—For doing a local infiltration: Sterile:

Three cc. Luer Lok syringe.
Ten cc. Luer Lok syringe.
Needles—1 No. 26 or 23 (short) and assorted lengths of No. 22, depending upon the size of the area to be anesthetized.
Medicine glass or beaker.
Applicators—as many as needed, and an antiseptic
Drapes.
Gloves.
Procaine or novocaine ampules.
Distilled water ampules.
Epinephrine ampule 1:1000 strength.

Procedure.—For doing local infiltration:

1. Assemble equipment.
2. Shave and scrub the area involved and apply antiseptic.
3. Open sterile materials. Open procaine ampule and empty into beaker. Add sufficient sterile distilled water to make the desired strength. (100 mg. of procaine in 10 cc. of water makes a 1 percent solution). Add the epinephrine. (For 10 cc. of anesthetic drug. 1 or 2 minims of epinephrine is sufficient.)
4. Scrub hands and put on sterile gloves.
5. Fill the 3 cc. syringe with procaine and attach the small needle.
6. Produce a large wheal (bevel of the needle held down) in the skin. This is the focal point from which you will make your injections. If, for instance, you are preparing the area for suturing a large laceration, several wheals will have to be produced.
7. After producing the wheal, change to a larger needle and syringe as the situation demands.
8. Plunge the needle right through the wheal and direct it in line with the laceration. The needle should be directed under the skin so that a blanching of the skin occurs when the solution is injected into the tissues. Express the solution ahead of the needle as you advance it.
9. Withdraw the needle slowly, but continue to express solution as you do so.
10. As the point of the needle nears the wheal, remove the syringe and refill if necessary. Then plunge the needle into the subcutaneous tissues and express solution there in the same manner as described above.
11. When one side of the wound has been infiltrated, repeat the procedure on the other side.
12. The infiltration should be made a few centimeters away from the wound.
13. The appearance (in contour) of the skin should be somewhat like orange peel after you have finished.
14. Action is almost immediate, and incising or suturing can be begun promptly.

Precautions

1. **Keep** the needle moving slowly, the solution ahead of the needle.
2. **Pull** on the plunger frequently, especially in the vascular areas to make sure you have not punctured a blood vessel. Hematomas may result as well as an enhancement of toxic effects.
3. **Remember** to puncture the skin as little as possible. That is the reason for producing the wheals (focal points).
4. **Under no circumstances** should the injections be made from within the laceration out into the tissues, nor should the injections ever be directed toward the laceration, as anesthesia is not

very effectual; it requires more puncturing, and also infection from the wound can easily be taken into the tissues.

5. **A sedative,** such as nembutal or seconal, is always in order to allay toxic effects of the anesthetic and to calm a patient who undoubtedly is experiencing apprehension.

Spinal Anesthesia

Definition.—Administration of anesthesia into the subarachnoid space of the spinal canal.

Site of injection.—Between the third and fourth or fourth and fifth lumbar vertebrae.

Position of the patient.

Lateral.—Knees sharply flexed, head brought forward.

Sitting.—Patient's feet rest on stool, hands folded in lap, head leaning forward on shoulder of assistant.

Drugs Most Commonly Used

Pontocaine.—Usually about 8 to 10 mg., depending upon the type of surgery to be done. Due to the fact that it is slightly lighter than the spinal fluid, it is often weighted with equal parts of 10 percent dextrose. Its action is prolonged—usually lasts 90 to 120 minutes.

Procaine (novocaine).—Dose 1 mg. per pound of body weight or 50 to 100 mg. total. Is lighter than spinal fluid. Generally mixed with spinal fluid for injection.

Equipment.—Sterile:

One 2-cc. syringe.

One 5- or 10-cc. syringe.

Five needles: Hypo, No. 21 and 23; spinal No. 18, 19, 20.

Four applicators.

Three flats.

One sacral towel.

One medicine glass.

One towel.

Gloves.

Antiseptic.

Drug to be used.

Procedure.—Your duties are those of assistant to the medical officer:

1. Assemble all equipment.
2. Put the patient in the position the doctor desires.
3. Prepare the area with antiseptic.
4. Have tray open and gloves at hand for the medical officer.
5. Hold the patient in position while anesthetic is being given.
6. After administration is finished, put the patient in the proper position. For solutions lighter than spinal fluid, lower the head. For solutions heavier than spinal fluid, raise the head. (The medical officer will instruct you as to the correct position.)

Precautions.—Keep in mind when helping with a spinal anesthetic:

1. A spinal anesthetic blocks the sensory, motor, and sympathetic nerves (the sympathetic nerves keep the blood vessels constricted normally); therefore when the block occurs, the blood pressure drops due to dilatation of the blood vessels. To prevent this, give ephedrine just before the anesthetic is started; 5 to 10 mg. is an adequate dose if given intravenously; 25 to 50 mg., if given intramuscularly or subcutaneously.
2. Prepare the patient mentally. Watch your conversation and remarks. Remember he is awake. Reassure him.
3. It requires about 3 to 4 minutes for procaine to become fixed and about 6 to 7 minutes for pontocaine. Changes of position of an anesthetized patient are dangerous immediately after the spinal is given. However, modification of the operating table is relatively safe, and any change made should not effect the level of anesthesia once it has become fixed.
4. **During the operation:**

   Keep check on blood pressure and pulse every 60 seconds if possible during the first 5 minutes, then every 5 minutes.

   Have a circulatory stimulant, such as ephedrine or epinephrine, at hand.

   If the anesthesia should bring about respiratory adversities, the medical officer may require artificial respiration as well as oxygen to be given.
5. **Toxic effects** of the anesthetic drug are the same in spinal anesthesia as in local. Should the patient be sensitive to the drug, he may have:

   Nausea, vomiting.

   Excitement.

   Rapid pulse.

   Pallor, syncope, breathing stops.

   Convulsions (if severe).

Sodium Pentothal or Sodium Amytal should be at hand with syringe and needle for intravenous administration.

GENERAL ANESTHESIA

Definition.—Complete loss of consciousness and sensation.

Stages of Anesthesia (4):

Stage 1.—Analgesia:

Patient begins to lose consciousness.

Reactions to pain and stimuli lessened..

Hearing becomes more sensitive; therefore surrounding areas should be kept quiet.

Sometimes used for minor dental work.

Stage 2.—Delirium or excitement state:

Often violent movement of arms; patient struggles.

May talk or cry.

Pulse rapid, skin flushed.

Lasts only a few minutes.

Stage 3.—Complete or "Surgical" anesthesia:

Patient is calm and quiet.

Muscles are relaxed.

Reflexes disappear.

Breathing deep and regular.

Four Planes of Stage 3 Anesthesia

Plane 1—Light.—Complete loss of all sensation. Pulse, respirations, and blood pressure are normal. Adequate for surgical work that does not involve the periosteum or peritoneum.

Plane 2—Deepening respiration.—Inspiration and expiration of the same length. Muscular relaxation sufficient for such operations as hernia, fractures, tonsils. Some respiratory paralysis is evident.

Plane 3—Deep anesthesia.—Intercostal muscles no longer assist with respirations; all diaphragmatic breathing. Inspirations somewhat delayed. Used only at the beginning of surgery when deep work is to be done and complete relaxation of the patient must be assured. Respiratory paralysis, however, has become marked and it is unsafe to keep a patient at this level of anesthesia for any length of time.

Plane 4—Paralysis of diaphragm.—Can be noted by sinking of the abdomen when the patient takes a breath. Breathing becomes very shallow. Cardiovascular system is seriously impaired.

Stage 4—Toxic stage.—Respirations cease, heart fails, death.

Remember.—When administering general anesthesia:

1. The cardiovascular and respiratory systems are closely linked. Both must be kept functioning properly. If one is affected, the other one is affected.

2. The blood must throw off carbon dioxide, which is considered a waste product. If it becomes stored up in the body, it will cause increased respiratory rate.

3. In cardiac failure, systolic and diastolic pressures go down and the pulse rate goes up.

4. Keep airway open from the nose to the alveoli. **Never leave an anesthetized patient alone.**

5. Under deep anesthesia, the reflexes in the pharynx and larynx become paralyzed. This can cause secretions to flow into the trachea and bring about respiratory obstruction.

6. Before beginning any type of general anesthesia, you should have certain equipment at hand and in good working order:

Oxygen and a means for giving artificial respiration, such as a re-breathing bag attached to the oxygen.

Intravenous fluids and equipment for giving same.

A vasoconstrictor such as ephedrine.

Sterile syringes and needles.

Airways.

Suction apparatus—a 30 to 50 cc. syringe and a No. 16 catheter do well if no other equipment is available.

Tiltable table so that the patient's head can be lowered if necessary.

Blood pressure apparatus.

Additional people to assist.

Types of General Anesthesia

Inhalation

Ether.—Offers a fairly wide margin of safety and is the only inhalation anesthetic agent that should be given under supervision by an untrained person. It will deteriorate rapidly upon exposure to light, heat, or air. Ether to be used for a gen-

eral anesthetic should be from newly opened containers.

Equipment

Ether can.—Before opening use older ether to clean all lacquer from the top of can. Cut out metal cap, replace with stopper from which a wedge has been cut on each side. In one side insert piece of gauze bandage as a wick to aid in control of ether from can. Or, without removing metal cap, insert safety pin through cap and pin a small piece of bandage to the pin. Try both methods to see which works best for the individual concerned.

Mask frame.—Cover with about 12 to 16 layers of gauze. (Just before using mask try a number of drops of ether to be certain that the ether will not leak through).

Mechanical airways.—Some type of protection for patient's eyes, preferably absorbent cotton; gauze or rubber tissue will do.

Suction apparatus.

Positive pressure oxygen equipment, if available.

Tongue blades.

Extra towels and emesis basin.

Extra cover for the mask.

Blood pressure apparatus.

Stethoscope.

Clock.

Be certain that all electrical equipment which may have to be used during the course of the anesthetic is plugged in. Be certain that the emergency light is working, and that the switch will not emit a spark if it has to be turned on.

Be certain that the assistant for the anesthetist knows that no smoking is permitted in the area, and that he has, if at all possible, a CO_2 fire extinguisher and knows how to operate it.

Ether is very highly flammable, ether fumes explosive. This must be remembered.

Precautions and procedures.—No fluids or food for 8 to 12 hours preceding anesthesia.

Remove loose dentures. Be certain that the patient has no other loose objects in the mouth, such as chewing gum.

Preoperative medications should include atropine. (The medical officer will prescribe).

Restrain patient well; arms with draw sheet, wide strap above knees. Be certain that the patient is in as natural a position as possible. The restraining apparatus should not be so tight as to interfere with circulation.

Never attempt to anesthetize a patient alone. Have an assistant standing by during the induction period.

Reassure the patient. Talk to him a minute or two before placing the mask over the face. The odor of ether is obnoxious to many people. If available place one or two drops of an essential oil; such as, oil of orange, spearmint, peppermint, or anise on the mask before beginning the anesthetic.

Avoid bright lights, especially overhead, if possible. Avoid any type of noise, talking, laughing, or similar noises.

Allow the patient's head to assume a natural position on the table without a pillow.

Start induction slowly, fast administration at the beginning may bring about a laryngospasm. Hold the little finger of the left hand slightly under the edge of the mask near the chin to permit a little air. After a few drops of ether have been placed on the mask and the patient has taken a breath or two remove the mask and let him take a few more breaths. Replace the mask and continue. Let him breathe again after a few breaths if there are signs of real fighting. As tolerance for the vapor increases, increase the speed of administration.

All patients respond differently to ether, and no set rule can be established as to rate of administration. Keep talking to the patient in a low voice, in other words "talk your patient to sleep."

Vomiting, retching, and aspiration are very apt to take place during the period of induction. If the patient vomits, be certain that the air passages are well cleared before proceeding.

In hot, moist climates ether does not vaporize well, condensation occurs. A towel wrapped around the face and adjoining the mask may aid in vaporization.

Keep the mask damp, not wet, change cover if necessary.

The medical officer will inform you when muscular relaxation is sufficiently good. The level of anesthesia should then be maintained.

If the patient has obstructed breathing, clear the air passages. Pull the tongue forward and bring the jaw forward by exerting pressure behind the angle of the jaw. An airway may be inserted if necessary.

Danger signs during anesthetic.—The pulse first increases then decreases; weak shallow respirations; ear lobes and base of finger nails begin to turn blue (cyanotic); pupils fail to react to light; blood pressure begins to fall.

If the patient begins to develop these signs remove the mask for 2 or 3 minutes. Be prepared to administer oxygen and either respiratory or circulatory stimulants, whichever are necessary. The surgeon will direct this.

Keep the surgeon informed as to developments. If it appears that the patient is receiving too much ether, inform him.

At times muscular rigidity may develop during abdominal operations. This may be an indication of too much ether. Remove the mask completely and permit to breathe normally for 2 or 3 minutes. This may reduce the rigidity. Resume anesthesia when rigidity is relaxed.

Discontinue ether gradually, as surgery comes to a close. Keep in mind that vomiting and possibility of aspiration are apt to occur during this period.

The patient should be awake when he returns to bed. Reflexes should be functioning.

Precautions that should be observed:

Do not permit woolen blankets to come in contact with the bare skin of patient. Use sheet for protection.

Just before beginning anesthetic have the deck of the room run over with a wet swab, do not dry. This will aid in grounding any static electricity that persons may create.

Have all persons who may enter the room touch metal just before entering. This may ground any static electricity.

Do not permit cautery to be used in room where anesthesia is being given.

Remember that ether fumes are heavier than air and will tend to sink toward the floor.

Other general inhalation anesthetics. (Never to be administered by an untrained person).

Chloroform.—Although not flammable or explosive, in the presence of an open flame, a highly toxic gas is generated (phosgene).

Vinothene. Ethylene.
Cyclopropane. Ethyl chloride.
Nitrous oxide.

Intravenous Anesthesia

Sodium Pentothal.—A barbiturate generally used in $2\frac{1}{4}$ percent solution.

Precautions.—Should be injected slowly, rate about 1 cc. each 30 seconds. When starting injections it is best to count, 1 and 2 and 3 and 4 up to 30, thus making certain that injection is not too rapid. It is easy to overdepress the patient with rapid injection.

Once Pentothal has been administered it cannot be removed from the blood stream.

It is a profound depressant to the respiratory and to a certain extent to the cardiovascular systems.

The possibility of laryngospasm is great.

Pentothal should primarily be used as an induction agent and as a supplement to other good anesthetic agents.

Pentothal used as an anesthetic does not give good muscular relaxation. This should be remembered, especially if to be used as the anesthetic in an abdominal operation.

Rectal Anesthesia

Avertin.—A dangerous central nervous system depressant that is used only in very carefully selected cases. Requires expert training to administer properly.

EMERGENCY DENTAL TREATMENT

Dental first aid is the temporary and emergency treatment for the relief of pain and discomfort given to persons suffering from disease or injury to dental structures until regular dental care can be given.

The treatment as outlined here is intended only for the relief of pain associated with, or occurring as a sequel to, trauma, infection, and postoperative complications. All cases receiving emergency dental treatment should be referred to a dental

officer as soon as possible for further treatment. The effectiveness of dental first aid depends upon an accurate diagnosis and the correct application of the remedies indicated. In order to render such treatment properly, one must have a general knowledge of the structures involved.

An oral examination reveals, in addition to the natural teeth present, the maxillae, mandible, and the tongue, all of which (except the teeth) are covered with mucous membrane. The roots of all teeth present are imbedded in the alveolar processes of the maxillae or mandible. In the area adjacent to the alveolar processes and surrounding the necks of the teeth is a fibrous tissue called the gingiva (gum).

The bulk of each tooth is composed of a bone-like structure called dentin, which is covered by enamel to form the crown and by cementum to form the root. The root of each tooth is attached to the alveolar bone by a fibrous tissue called the periodontal membrane. Within the crown and root of a tooth is a filament of soft tissue called the pulp. The nerves and blood vessels enter and leave the pulp through openings at or near each root end or apex (fig. 116).

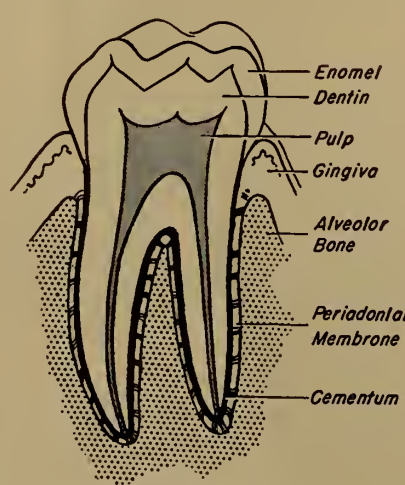

Figure 116.—Sketch of Molar Tooth and its Supporting Structure.

There are 32 teeth in the normal, permanent dentition; there are 16 in each jaw or arch. Each normal arch of 16 teeth possesses 4 incisors, 2 cuspids, 4 bicuspids, and 6 molars. In the Armed Forces System of Classification these teeth are numbered from 1–32, beginning with the upper right third molar or wisdom tooth and continuing to the upper left third molar which is No. 16. The lower left third molar is number 17 and, continuing around the lower arch, the numbering ends on the lower right third molar which is No. 32 (fig. 117). The understanding of this nomenclature will enable the hospital corpsman to accurately record any emergency treatment in the patient's Dental Record (NavMed H–4). The Manual of the Medical Department should be consulted for

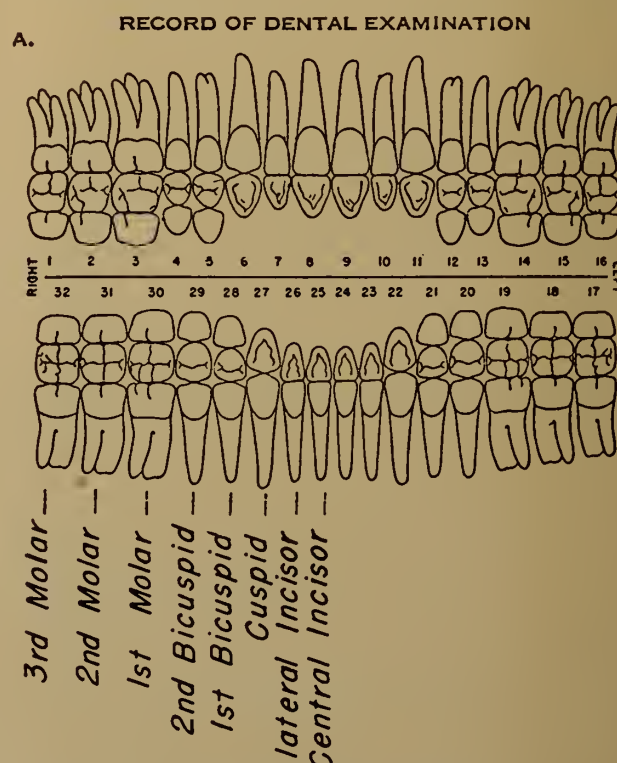

Figure 117.—The Dental Record Chart of the Form H–4. Tooth nomenclature has been added.

detailed information pertaining to method and procedure for making such entries as well as instructions pertinent to obtaining dental services from naval or civilian sources.

Since pain or discomfort may be indicative of a serious pathologic condition, all cases which receive emergency treatment must be referred to a dental officer as soon as possible for professional and definitive treatment. The hospital corpsman on independent duty should make every attempt to prevent conditions which might result in dental emergencies. By using intelligent forethought, the corpsman can arrange for periodic examinations and treatment of the men attached to his ship or station at such times as the services of a dental

officer are available to them. Health records should be examined to determine if they contain up-to-date dental records. If they are missing or not up-to-date, he should assure himself that they are supplied or corrected since they may furnish the only means of positive identification if such a need arises. In addition, a current dental record will be of valuable assistance should dental first aid measures become necessary.

The personnel of craft, not having a dental officer attached, should be examined by the hospital corpsman prior to arriving in port for the purpose of classifying the crew into the following categories:

1. Those requiring or having received emergency treatment.
2. Urgent dental attention indicated but not of an emergency nature.
3. Routine treatment indicated.
4. No dental complaint but the individual requests a dental appointment for the purpose of a check-up.
5. No dental complaint and the necessity for a dental appointment is not indicated nor requested.

The list of personnel requiring or requesting dental treatment should be delivered without delay to the shipyard dental officer or the dental officer of a tender, whichever is applicable, for the purpose of expediting dental treatment in the order of established priority. It must be remembered that, as a general rule, dental departments of ships or shore stations have a large backlog of personnel awaiting treatment and it is not always possible to provide all of the dental treatment which is required in each case.

In order to determine the first aid procedures to follow, one will find in this section a reference table which describes some of the more common dental complaints and symptoms together with a diagnosis and a palliative, temporary treatment. Many conditions exist, however, which have not been included for reasons that they may tend to confuse the diagnosis. In those cases where a diagnosis cannot be determined from the signs and symptoms outlined in this reference table, certain therapeutic principles can be employed on a temporary basis until professional assistance can be obtained. These principles will not necessarily cure nor harm the patient, but in most cases they will alleviate suffering and minimize complications until such time as the patient can be given more effective care. They include the application of:

1. Analgesics, hypnotics, or narcotics for the relief of pain.
2. Warm or hot saline mouthwashes and gargles.
3. Antipyretics for fever.
4. Antibiotics or chemotherapy (or both) in full therapeutic dosage.
5. Bed rest.
6. Light and substantial diet.

For ready reference the table has been divided into the following categories: Stomatitis (inflammatory conditions of the mouth), odontalgia (toothache), traumatic injuries, serious dental infections, post surgical emergencies, tumors, and other dental conditions. Refer to the proper category and check through the respective complaints and symptoms which will lead to an appropriate diagnosis and treatment.

For the rendering of dental first aid the following armamentaria are suggested. These can be requisitioned as desired to supplement supplies and equipment that may be on hand.

Instruments	Accessories
Excavators:	Floss, dental
Instrument, cutting, Black, nos. 63–66	Gauze, iodoform ½ inch
Handle, mouth mirror	Pad, cement mixing, paper
Mirror, mouth, No. 4	Pellets, cotton
Pliers, No. 6 (cotton)	Rolls, cotton
Spatula, cement, No. 324	Slab, mixing (or pad)
Syringe, water, Moffat	

Drugs

Acriflavine hydrochloride, 1 percent aqueous solution	Hydrogen peroxide
Analgesics	Protective ointment
Collodion, flexible	Sodium bicarbonate
Eugenol	Spirits of camphor
	Zinc oxide

DIAGNOSIS AND TREATMENT TABLE

Stomatitis

Herpetic stomatitis.
Alcoholic stomatitis.
Infectious stomatitis (fig. 118).
Noninfectious stomatitis (fig. 119).
Aphthous ulcer (fig. 120).
Traumatic ulcer, infected (fig. 121).
Pericoronitis (fig. 122).
Pericoronal abscess (figs. 123, 124).

Denture stomatitis—nontraumatic (fig. 125).
Denture stomatitis—traumatic (fig. 126).
Marginal gingivitis (figs. 127, 128).
Mild gingivitis (fig. 129).
Vincent's infection (figs. 130, 131).
Vincent's angina.
Dry, burning tongue (fig. 132).
Herpes labialis (fig. 133).
Cheilitis.

Odontalgia:

Simple toothache (figs. 134, 135, 136, 137, 138, 139, 140).
Severe toothache, A, B, C (figs. 141, 142, 143, 144, 145, 146, 147, 148, 149, 150).
Periodontal abscess (figs. 151, 152).

Traumatic injuries:

Jaw fractures (figs. 153, 154, 155, 156).
Tooth fractures (figs. 157, 158, 159, 160, 161, 162, 163).
Chemical burns.
Thermal burns.

Serious dental infections:

Cellulitis (figs. 164, 165).
Peritonsillar abscess.
Ludwig's angina.
Acute osteomyelitis.
Cavernous sinus thrombosis.

Post surgical emergencies:

Hemorrhage.
Sequestra.
Dry Socket (figs. 166, 167, 168).

Tumors

Other dental conditions:

Black tongue.
Geographic tongue.
Torus palatinus (fig. 169).
Torus mandibularis (fig. 170).
Obstructive salivary calculus.

STOMATITIS

An inflammatory condition of the oral mucosa due to local disorders such as trauma, infection, or neoplasm, or to general systemic disorders such as avitaminosis, blood dyscrasia, or disease state. Stomatitis is evident whenever soft tissues of the mouth are painful. Relief of pain is primary concern—prevention of further infection and, if possible, elimination of basic causes also are important.

Herpetic Stomatitis

Complaint.—"Sore mouth" "Many ulcers."

Symptoms.—Entire mucosa inflamed, many small greyish ulcers surrrounded by reddish halo. Very painful, fever often present, spontaneous bleeding from gingivae, duration 10–14 days.

Treatment.—1. Antipyretics for fever if present (aspirin, 5 grains, q 4 h).

2. Force fluids.

3. Sodium bicarbonate mouthwashes three times daily. (Approximately 2 percent solution—1 teaspoon in glass warm water.)

4. Advise proper oral hygiene and avoid irritants such as spicy foods.

5. Relieve and treat upper respiratory infection if present. (See The Nose, under Emergency Medical treatment.)

Alcoholic Stomatitis

Complaint.—"Sore tongue" "Sore gums."

Symptoms.—Tongue hypersensitive. Tongue shows ulcers on sides and tip. Gingivae and mucous membranes very red, swollen and tender—sometimes ulcerated. Somewhat resembles Vincent's infection. Tongue swollen, red, sore, and has impressions of teeth on sides and tip. Seen in heavy drinkers (alcoholic pellagra).

Treatment.—1. Multiple vitamin therapy. (Hexavitamin, tabs 1 t. i. d.)

2. Encourage strict oral hygiene.

3. Assure that patient receives an oral prophylaxis and instruction in oral hygiene.

4. Discourage consumption of any alcoholic beverages.

Infectious Stomatitis

Complaint.—"Sore mouth."

Symptoms.—Fiery red mucosa. (See pl. II–A) Accompanying nasal, throat, and bronchial catarrh. Usually acute. Early itching sensations. Cheeks may be involved, also palate. Tongue and lips may be swollen. Increased pain when eating. Tender regional lymph nodes. Fever 102°–104° F. Sore throat, foul breath.

NOTE.—May be complicated by Vincent's infection.

A

B

C

D

E

F

Treatment.—1. Mild mouthwashes with sodium bicarbonate and water (2 percent solution).

2. Reduce or eliminate smoking.

3. Apply protective ointment to lips as indicated.

4. Improve general body resistance through diet, fluids, etc.

5. Treat fever with antipyretic (aspirin, 5 grains, q 4 h).

6. Bed rest.

7. Gargles and mouthwashes as appropriate.

Figure 118.—Infectious Stomatitis. Mucosa fiery red. Gingiva, lips and tongue may be swollen.

Non-Infectious Stomatitis

Complaint.—"Sore and painful mouth."

Symptom.—Inflamed mucosa, redness and swelling of gingivae. Desquamation of epithelium. Tissues look burned. May be chronic—usually acute.

Treatment.—1. Reduce or eliminate smoking.

Figure 119.—Non-Infectious Stomatitis. Gingiva appears slightly red and swollen, entire mucosa inflamed and raw. Isolated areas may desquamate as illustrated.

2. If due to ill-fitting dentures, remove permanently and treat with mild alkaline mouthwash (2 percent solution sodium bicarbonate).

3. Advise patient to avoid hot foods or irritants.

4. If due to toothache remedies (chemical burns, aspirin, etc.) instruct patient to avoid their use.

5. Edema is reduced by sucking ice.

6. Arrange for treatment of dental defects.

Aphthous Ulcer Canker Sore-Dyspeptic Ulcer

Complaint.—"Ulcer(s) or sores in mouth."

Symptoms.—Round or oval, greyish ulcers 2–3 mm. in diameter, may coalesce with others to form large and irregularly shaped ulcer. Each lesion

Figure 120.—Aphthous Ulcers may be found anywhere in oral soft tissues. Small greyish ulcers may coalesce with others to form a large irregularly shaped ulcer.

is surrounded with reddish halo. (See pl. II, B.) Very painful, may accompany gastrointestinal upsets. Rare on soft palate but may be seen anywhere on soft tissues of mouth. May tend to recur. Usually heals without treatment in 7 to 10 days.

Treatment.—1. Pain may be relieved by carefully touching ulcer with very small drop of silver nitrate and following immediately with a drop of eugenol to stop the caustic action of silver nitrate.

2. Avoid acid foods and irritants (mustard, catsup, lemon juice, etc.)

3. Encourage increased fluids and substantial diet.

Traumatic Ulcer

Complaint.—"Sore in mouth."

Symptoms.—History of trauma by instrument, tool, pencil, toast, bone, toothbrush, or biting of tongue, cheek, or lips. Abraded or lacerated mucosa. Palate is common site. May be secondarily infected by mouth organisms to form an ulcer with a definite border and crater re-

Figure 121.—Traumatic Ulcer of Tongue. An initial traumatic lesion of oral mucosa may become infected to form this ulcer which resembles an aphthous ulcer.

sembling an aphthous ulcer. Duration, 3 to 7 days.

Treatment.—1. Alkaline aromatic solution tablets (1 tablet in glass warm water as mouthwash).

2. Instruct patient in oral hygiene.
3. Proper diet of bland foods.
4. If rough tooth is cause, smooth area with small piece of sandpaper.
5. Observe carefully for normal healing.

Acute Pericoronitis

Complaint.—"Sore wisdom tooth" "Gum around wisdom tooth sore."

Symptoms.—Gum tissue in area of third molar inflamed. Difficult to open and close jaw. Short history—spontaneous onset. May be complicated by Vincent's infection. Coated tongue and odor. Sometimes fever. May develop cellulitis or peritonsillar abscess.

Treatment.—1. Relieve pain with analgesic (aspirin, 5 grains, or APC, 5 grains, prn). Local application of counterirritants may be helpful (tincture of benzoin compound).

2. Frequent mouthwashes and gargles with warm or hot saline solution.
3. Institute antibiotic therapy (penicillin, crystalline G 300,000 U every 12 to 24 hours intramuscularly).
4. If Vincent's infection present, treat accordingly.

Figure 122.—Acute Pericoronitis. This condition is more commonly observed in the mandibular third molar area.

Pericoronal Abscess (Infection)

Complaint.—"Sore wisdom tooth" "Gum around wisdom tooth sore."

Symptoms.—Pus may be present. Swelling more pronounced, pain less than acute pericoronitis. Longer history—may have had one or more previous acute infections.

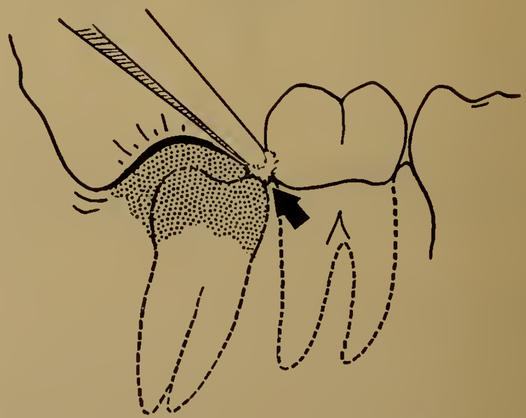

Figure 123.—Pericoronal Abscess. Large local swelling. Pus may be present. A small pellet of cotton moistened with Tincture of Benzoin compound may be locally applied to area shown.

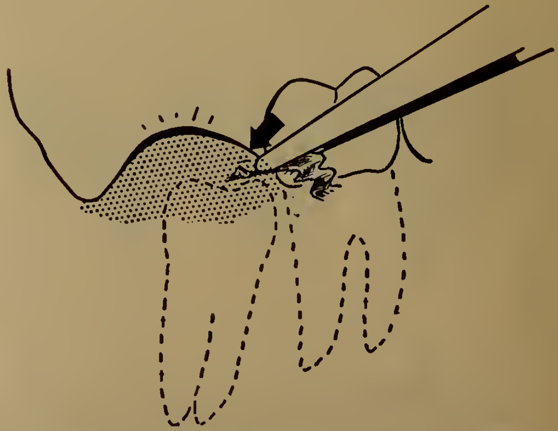

Figure 124.—Pericoronal Abscess. Drainage may be improved by inserting short strip of iodoform gauze under swollen flap of tissue as shown.

Treatment.—1. Provide drainage by carefully inserting a short strip of iodoform gauze as a "wick." (See fig. 124.)

2. Fluids.

3. Institute antibiotic therapy (penicillin, crystalline G 300,000 U every 12 to 24 hours intramuscularly.

4. Frequent mouthwashes and gargles with warm or hot saline solution.

Denture Stomatitis (Nontraumatic)

Complaint.—"Sore mouth under denture."

Symptoms.—Mucous membrane that is covered by dentures appears inflamed. Gingivae appear raw and sore. General oral hygiene poor or neglected.

Figure 125.—Denture Stomatitis (Nontraumatic). Oral mucosa raw-looking in regions covered by dentures. Inflammation may be particularly intense in certain areas about teeth.

Treatment.—1. Thoroughly scrub dentures with soap and water and place in a saturated solution of sodium bicarbonate overnight.

2. Instruct patient to maintain strict oral hygiene.

3. Avoid hot and irritating foods.

4. Leave dentures out of mouth during healing.

5. Maintain absolute cleanliness of dentures.

Denture Stomatitis (Traumatic)

Complaint.—"Sore mouth under denture."

Symptoms.—Mucosa normal except in specific area of soreness. Patient usually complains that dentures do not fit properly. Ulcers may be present in area of irritated mucosa. Soreness may be at edge of denture or under it. Denture may be cracked or broken.

Treatment.—1. Leave denture out of mouth during healing.

2. Carefully paint area with tincture of benzoin compound.

3. Only a dental officer should remove traumatogenic area of denture.

Figure 126.—Denture Stomatitis (Traumatic). Local areas of inflammation are associated with traumatic injury from ill-fitting dentures. Ulcers may result when these areas become infected.

Marginal Gingivitis

Complaint.—"Sore gums" "Bleeding gums."

Symptoms.—Usually localized inflammation in gingival area between the teeth; may be present in more than one location or may be general. Teeth in area of inflammation may be carious; food may be impacted in carious lesions between the teeth. Gingivae appear red and swollen at their margin. Pressure upon reddened areas causes slight bleeding. Tooth alinement may be faulty allowing food impaction and preventing proper cleansing. Brushing of teeth usually causes bleeding. Soreness, but not severe pain. Gingivae are smooth, red, and glistening rather than pink and stippled.

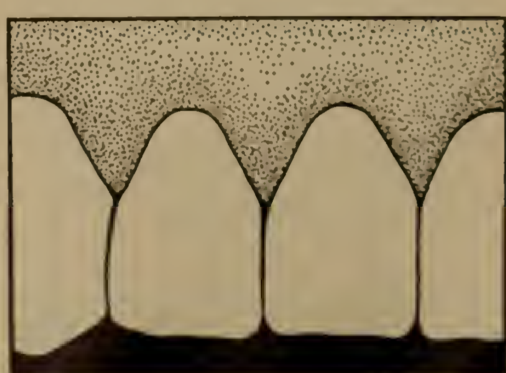

Figure 127.—Normal appearance of gingiva about necks of teeth.

Figure 128.—Marginal Gingivitis. Local swelling of gingiva in one or more areas between teeth. Slight bleeding may result when these areas are touched.

Treatment.—1. Carefully remove impacted food by using dental floss.

2. Irrigate area with warm water or warm saline solution.

3. Paint area with mild tincture of iodine, U. S. P.

4. Advise patient to avoid consumption of irritating and spicy foods and stringy meats which tend to catch and hold between the teeth.

5. Prescribe frequent saline mouthwashes.

6. Advise patient to avoid gingivae when brushing the teeth until condition has improved.

7. Ascertain dietary habits and correct if indicated.

Mild Gingivitis

Complaint.—Bleeding gums—When I brush my teeth, or eat an apple, etc.

Symptoms.—Slight bleeding when gingiva touched. Carious teeth may be present as they provide focal point for infection. Slight tenderness. Sucking on gums may produce bleeding. Usually oral hygiene is neglected or mucosa has been irritated by prolonged smoking and/or drinking alcoholic beverages. If bleeding is of long duration, patient may have hemorrhagic history.

Treatment.—Usually due to local causes—hence:

1. Instruct patient to brush teeth thoroughly and frequently.

2. Frequent use of a mild alkaline mouthwash (2 percent solution sodium bicarbonate).

3. Instruct patient to stimulate gums with finger massage.

4. Avoid irritants—check diet and vitamin intake.

5. If bleeding is of long duration, refer to a dental or medical officer at the first opportunity.

Vincent's Infection

Complaint.—"Bleeding gums" "Trench mouth."

Symptoms.—Severe soreness and bleeding of gums and bad taste in mouth. (See pl. II, C.) Low resistance of oral tissues probable predisposing factor. Fever of 99° to 102° F. Gingivae between the teeth are red and swollen, or necrotic with a greyish slough. Removal of necrotic membrane leaves bleeding surface. Hemorrhage may result during act of rinsing mouth with water. Evidence of poor oral hygiene usually—progress of disease prevents good oral cleanliness. Increased flow of saliva; drooling. General feeling of depression. Foul odor to breath. Adenopathy may be present. Persists for many days—even months, if no treatment rendered. May be a complication of pericoronitis.

Figure 129.—Mild Gingivitis. Gingival margins slightly swollen and inflamed. Bleeding from gingiva on sucking. Gum tissue below gingiva not involved.

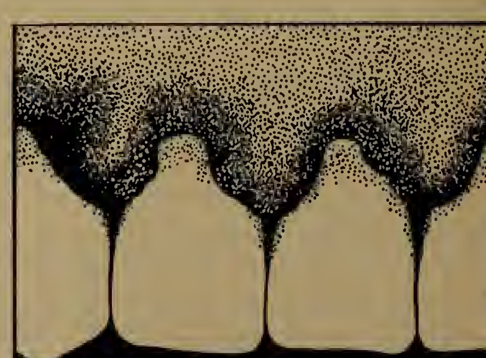

Figure 130.—Early Vincent's Infection. Gingiva between teeth inflamed and tender. There is poor oral hygiene. Brushing teeth causes bleeding.

Figure 131.—Late Vincent's Infection. Gingiva between teeth and later around teeth become neucrotic with characteristic greyish sloughing. Bleeding occurs with slightest irritation and gingiva are very painful.

Treatment.—1. See patient daily during acute state (4 to 7 days).

2. Clean teeth, gingival tissue and mucous membrane with hydrogen peroxide solution, U. S. P., 3 percent, using swabs or pellets.

3. Penicillin troches containing 5,000 units, may be prescribed, one troche each hour.

4. Frequent oral rinsing with a solution of Hydrogen Peroxide and water. (Two teaspoons hydrogen peroxide solution, U. S. P., 3 percent in half glass water.)

5. Bed rest advised.

6. Balanced diet, supplemented with vitamins (multiple) (Hexavitamins tabs., 1 o. d.).

7. Laxative if necessary. (Cascara Sagrada. 3 to 15 grains).

8. Refrain from brushing during acute (febrile) stages. Discontinue smoking.

9. Antipyretic for fever (aspirin 5 grains q 4 h).

Vincent's Angina

Complaint.—"Sore mouth, gums, and throat."

Symptoms.—Fever to 104° F. Gingivae, cheek, side of tongue, fauces, and tonsils may be involved; infection may be confined to throat alone. Large ulcers with greyish-brown surfaces. Membrane firmly attached. May be complicated by periodontal disease (pyorrhea). Thought to be secondary infection only. Predisposition must be present.

Treatment.—1. Measures to improve local tissues:

a. Advise frequent mouthwash and gargle with hydrogen peroxide, U. S. P., 3 percent diluted to half strength with water.

b. Judicious and careful oral hygiene.

c. Avoid irritants.

2. Measures to improve systemic conditions:

a. Balanced diet and force fluids.

b. Antibiotic (penicillin, crystalline G,300,000 U every 12 to 24 hours).

c. Rest.

d. Improve elimination with mild laxative if necessary.

Dry Tongue-Burning Tongue

Complaint.—"Dry, burning tongue."

Symptoms.—A symptom of many systemic diseases—pellagra, pernicious anemia, disturbances of gastric secretion and psychoneurosis. Sometimes present in shock and severe hemorrhage. Indicates state of dehydration. Look for local irritations from dentures, restorations.

Treatment.—1. Attempt to find underlying cause of systemic or irritational origin.

2. Proper diet.

3. Treat for shock if necessary.

4. Force fluids.

5. Advise mild alkaline mouthwashes. Dissolve one tablet (alkaline aromatic solution, tablets) in a glass of water. Use as mouthwash four times daily.

Herpes (Labialis)

Complaint.—"Fever blisters" "Cold sores."

Symptoms.—Burning sensation is early symptom. Early swelling of a local lip area to form

Figure 132.—Herpes Labialis. Small blister-like vesicle on lip. May coalese with others to form cluster. Late stages show crusting and desquamation of lip mucosa.

small vesicles. Vesicles may form in clusters. Crusting and desquamation of mucosa.

Treatment.—1. Check patient for fever.

2. Check patient for influenza.

3. Apply spirits of camphor locally 3 to 4 times a day.

4. Avoid exposure to sun.

Cheilitis (Cheilosis)

Complaint.—"Sores at corner(s) of mouth."

Symptoms.—Begins as redness and peeling of skin at angles of mouth. Cracks in skin occur as peeling continues. Similar lesions often seen at the naso-labial groove. Often associated with prolonged nutritional deficiencies. Often subject to secondary infection from saliva and skin contamination.

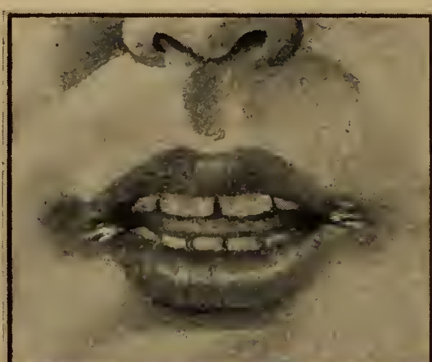

Figure 133.—Cheilitis. Begins as redness and peeling at corner of mouth. Skin cracks to give characteristic appearance of this inflammation.

Treatment.—1. Prescribe riboflavin tablets in dosage of 2 milligrams (0.002 gm.) five times a day.

2. Apply protective ointment to involved area.

3. Attempt to prevent secondary infection by strict cleanliness, care in shaving, and discriminate eating habits.

4. If infected, cleanse daily with soap and water and apply anesthetic ointment containing butyn and metaphen.

5. Adequate diet essential; increase fluid intake and maintain proper bowel function.

ODONTALGIA—TOOTHACHE

Toothache or odontalgia is a typical response of the dental pulp to irritation, inflammation, or infection. Stimuli which are responsible for the production of pain are of varying types: chemical (drugs, food, liquids, etc.), traumatic (blow, uneven occlusion, high fillings), dental caries (tooth decay), which may in itself irritate or infect the dental pulp. Other conditions which are usually manifested by symptoms commonly attributed to toothache are also included in this category.

Erosion or Hypersensitive Dentin

Complaint.—"Simple toothache."

Symptoms.—Neck of tooth is sensitive when touched with toothbrush bristles or fingernail. Tooth may also be sensitive to sweets and/or fruit juices. Tooth may appear to be wearing away at gingival margin.

Treatment.—1. Apply sodium bicarbonate paste over sensitive area. (Thick paste of water and sodium bicarbonate), or paint glycerin over dried sensitive area.

2. Advise use of alkaline toothpaste. (Thick paste of water and sodium bicarbonate).

3. Avoid irritating foods.

Figure 134.—Erosion at "neck" of tooth. Area sensitive to touch.

Simple Pulpitis or Sub-Acute Pulpitis

Complaint.—"Simple toothache."

Symptoms.—Irritation may be produced by sweets and either hot or cold liquids. Sharp, throbbing, intermittent pain. Pain may increase when reclining. Not painful to percussion. Cavity may be visible (fig. 135). There may be a loose or broken filling in tooth.

Treatment.—1. Carefully remove debris from carious tooth with excavator or remove loose filling (fig. 136).

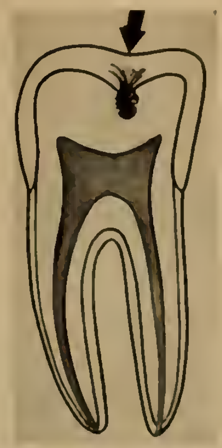

Figure 135.—Beginning Caries. Simple Pulpitis. Tooth is slightly sensitive to cold or hot liquids and sweets.

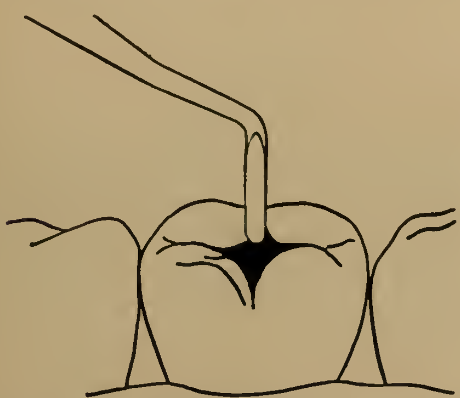

Figure 136.—Simple or Sub-Acute Pulpitis. Remove caries and debris with excavator.

Figure 137.—Flush cavity with warm water.

Figure 138.—Dry cavity with cotton pellet.

2. Wash out cavity with warm water (fig. 137).

3. Dry cavity with clean cotton pellet (fig. 138). Insert another small pellet moistened with eugenol (fig. 139).

4. Fill cavity with zinc oxide and eugenol paste as temporary filling (fig. 140).

NOTE.—Mix zinc oxide powder with two drops eugenol on glass slab or paper pad. Add enough zinc oxide to make a putty-like consistency.

5. Analgesic as indicated (APC, 5 grains prn.).

Figure 139.—Insert cotton pellet moistened with eugenol into cavity.

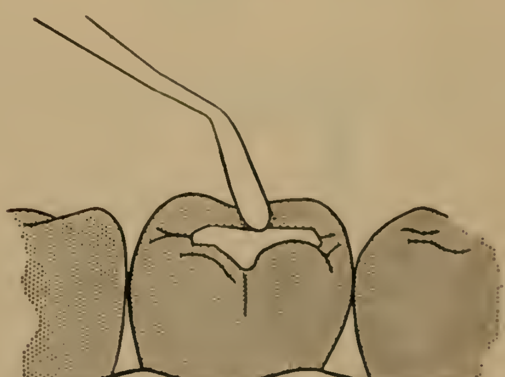

Figure 140.—Fill cavity with paste of zinc oxide and eugenol.

Acute Pulpitis

Complaint.—"Severe toothache". A.

Symptoms.—Tooth usually shows extensive caries, large restoration, or has history of trauma (fig. 141). Dull or severe, continuous pain. Heat increases pain; cold relieves as pulpal infection increases (fig. 146). Pain usually more severe when food impacts in cavity. Later, tooth may be tender to percussion.

Treatment.—1. With excavator remove as much débris from cavity as possible.

2 *a.* If pain increases suddenly, discontinue and insert 1–2 drops of eugenol and cover with zinc oxide and eugenol paste. Do not pack (figs. 142, 143, 144, 145).

Figure 141.—Deep caries with pulpal exposure. Acute Pulpitis. Irritable to any temperature change and food impaction.

Figure 142.—Carious—exposure. Acute Pulpitis. Remove as much caries and debris as possible. If sharp pain produced, stop immediately.

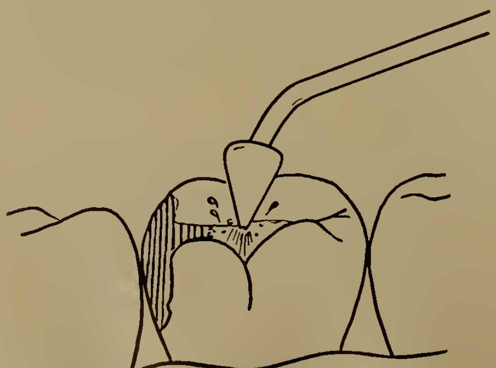

Figure 143.—Wash out cavity with warm water.

Figure 144.—Dry cavity with cotton pellet and insert cotton dressing moistened with eugenol.

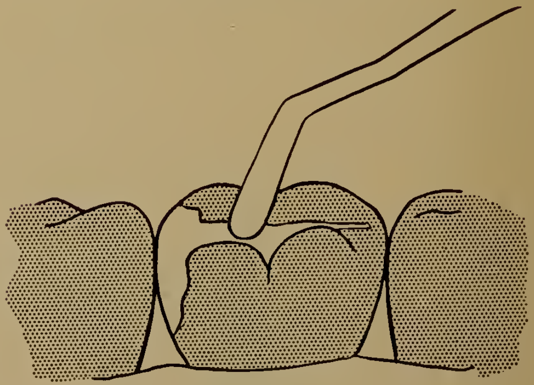

Figure 145.—Fill cavity with soft paste of zinc oxide and eugenol. Do NOT Pack.

Figure 146.—Deep caries with pulpal exposure causing pulp death. Infection of pulp may extend beyond root and form abscess. Tooth sensitive to hot fluids, relieved by cold. Sensitive to percussion.

b. If pain decreases upon removal of decay leave cavity open and insert pellet of cotton to prevent food from impacting (figs. 147, 148).

3. Remove pellet and flush cavity with warm water at 24 hour intervals to keep cavity clean.

Figure 147.—Carious Exposure. Pulp dying. Remove as much caries and debris as possible. If pain stops suddenly discontinue caries removal.

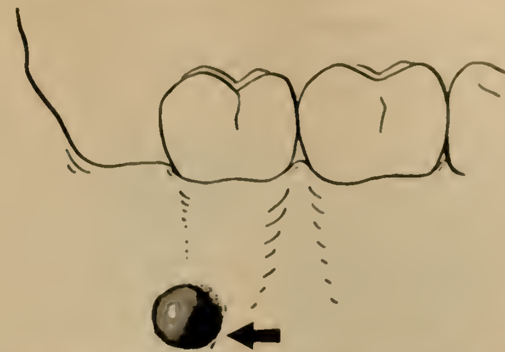

Figure 149.—Periapical Abscess resulting from deep caries and pulp death. Spontaneous drainage may be established through fistula and "gumboil."

Figure 148.—Wash out cavity with warm water and gently place cotton pellet at bottom of cavity.

Figure 150.—"Gumboil" developed from periapical abscess. Note position as compared with that of a periodontal abscess.

Place clean cotton pellet into cavity each time.

4. Analgesic as indicated (APC, 5 grains, prn.).

Acute Periapical Abscess

Complaint.—"Severe toothache". B.

Symptoms.—Same as A (above) except tooth is always tender to touch and pain is constant and throbbing. Face or jaw may be swollen in area of affected tooth. Tooth may be loose in socket. A fistula or a "gumboil" may be present (figs. 149, 150). (See pl. II, D.)

Treatment.—1. Debris and soft dentin should be carefully removed with excavator.

2. Open cavity to pulp—establish drainage from cavity.

3. Flush with warm water and insert pellet of cotton into cavity to prevent food impaction.

4. If no cavity is visible, use antibiotics. (Penicillin, crystalline G 400,000 U every 12 to 24 hours. Aureomycin, 500 mg. stat. and 250 mg. q 6 h. not to exceed 3 days.) Fistula may not form if antibiotics are used. Never incise for drainage.

5. Analgesic as indicated. (APC, 5 grains, or codeine, ½ grain, prn.)

6. Repeat item 3 daily.

Figure 151.—"Gumboil" developed from a periodontal abscess.

Periodontal Abscess or "Pyorrhea" Abscess

Complaint.—"Severe toothache". C.

Symptoms.—Cavity may not be present. Inflammation of gingiva about tooth or teeth. Tooth may be loose. Painful to touch and feels elongated to patient on closure. Swelling and "gumboil" closer to crown than with apical abscess. Deep pocket about tooth often produces pus. If adequate drainage is present a "gumboil" will not form. (See pl. II, E.) Tooth not painful to heat or cold.

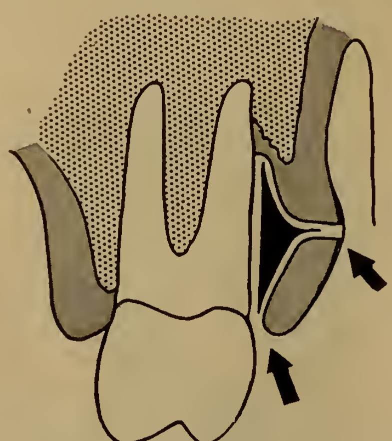

Figure 152.—Periodontal Abscess. Pocket formation along side of root is followed by infection and formation of fistula and "gumboil". Drainage may also be established at gingival margin.

Treatment.—1. Have patient hold hot saline solution in mouth every 15 minutes.

2. Paint adjacent area with mild tincture of iodine as counterirritant.

3. When pus appears at gum margin or through fistula, encourage continuous, free drainage with sterile, blunt-tipped instrument.

4. Continue vigorous mouth rinses to keep pocket clean.

5. Analgesic as indicated. (APC or codeine, ½ grain, prn.)

TRAUMATIC INJURY

Trauma to structures of the mouth may affect the tooth, the supporting or investing tissues of the teeth (bone and membrane of the periodontium), or the jawbones. Such injuries may occur from blows, wounds (gunshot and others), falls, uneven bite relationship and bizarre injury to oral tissues from pencils, toothpicks, food impactions, burns, etc.

Jaw Fracture

Complaint.—"Broken jaw" "Teeth out of line" "Blow to jaw—cannot bite as before."

Symptoms. — Localized pain. History of trauma. Difficult or impossible to open or close mouth. Hemorrhage may be present. May be loose or broken teeth present.

Treatment.—1. Do not manipulate bone ends unless there is hemorrhage. To stop hemorrhage it may be necessary to carefully manipulate jaw with fingers to move bone ends into proper position (fig. 153). Immobilize.

Figure 153.—To control hemorrhage in area of fracture it may be necesary to attempt careful repositioning of the fractured parts until teeth can be brought together properly and jaws immobilized.

2. To immobilize see figure 154, 155, 156. Keep bandage well forward to prevent impingement on airway.

3. Narcotics and analgesics for relief of pain. (Morphine sulfate, ⅙ to ¼ grains, IM; or codeine, ½ grain, prn. and APC.)

4. Bed rest.

5. Liquid diet.

Fractured Tooth

Complaint.—"Broken crown of tooth."

Symptoms—*Type I.*—Portion of tooth crown lost but pulp not exposed. Tooth not loose. Tooth very sensitive to air and temperature changes.

Treatment.—1. Exposed surface may be dried and coated with collodion.

2. Smooth sharp edges with sandpaper.

Figure 154.—Modified Barton bandage for immobilization of jaw fractures.

Figure 156.—Seaman's cap may be used in emergency by cutting away a portion of brim and positioning as illustrated.

Figure 155.—Four-tailed bandage for immobilization of jaw fractures.

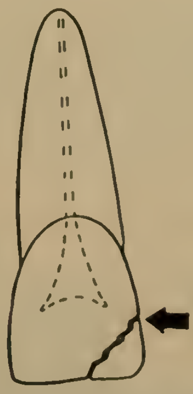

Figure 157.—Type I Fractured Tooth. Small portions of crown broken. No pulpal exposure. Slight sensitivity.

Fractured Tooth

Complaint.—"Broken crown of tooth" (continued).

Symptoms.—*Type II.*—Sufficient portion of tooth lost to expose pulp slightly (fig. 158). Tooth not loose. Very painful to air or temperature changes. Difficult to masticate food without causing pain.

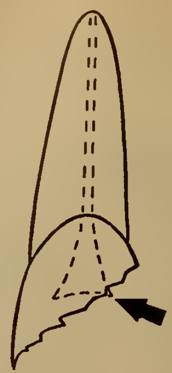

Figure 158.—Type II Fractured Tooth. Slight exposure of pulp. Very painful to thermal changes and to touch in exposed areas.

Treatment.—1. Cover area with a zinc oxide and eugenol and cotton fiber splint (figs. 159, 160.)

2. Place on bland diet until inflammation subsides.

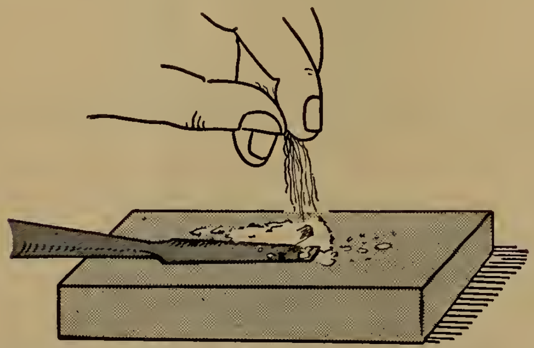

Figure 159.—Addition of cotton fibers to mix of zinc oxide and eugenol provides more bonding strength.

Figure 160.—Splint of zinc oxide and eugenol paste containing cotton fibers.

Fractured Tooth

Complaint.—"Broken tooth" (continued).

Symptoms—Type III.—Large fracture of crown, exposing large portion of pulp. (See pl. II, F.) Tooth not loose. Very painful to air, fluid, and mastication on exposed pulp. Pulpal hemorrhage usually present.

Treatment.—1. Make large splint of zinc oxide and eugenol with cotton fibers and place over lingual and labial of tooth. Allow to harden for several hours (fig. 159).

2. Advise bland diet.

Figure 161.—Type III Fractured Tooth. Pulp well exposed resulting in hemorrhage. Extremely painful to touch and thermal changes.

Figure 162.—Type IV Fractured Tooth. Root fractured. May be complicated with break in crown. Tooth mobile.

Fractured Tooth

Complaint.—"Loose tooth from fall or blow."

Symptoms—Type IV.—Tooth loose with or without fracture of crown (fig. 162). Root of tooth may be fractured. Thermal reactions dependent upon presence and extent of any coronal fracture. Tooth may be painful to movement.

Treatment.—1. Make splint of zinc phosphate cement for labial or buccal and lingual of tooth, if pulp is not exposed. Or make splint with zinc oxide and eugenol and cotton fiber (fig. 163).

2. Advise bland diet.

Figure 163.—Splint of zinc oxide and eugenol paste containing cotton fibers covers wider area over teeth and gums.

Chemical Burn

Complaint.—"Sore mouth" "Burned mouth."

Symptoms.—Frequently caused by placing aspirin against gum tissue to stop toothache. White plaque on mucous membrane. Painful.

Treatment.—Paint a 1 percent aqueous solution of crystal violet to area twice daily to prevent secondary infection.

2. Advise patient that aspirin should be swallowed if used at all. Other so-called "remedies" also may be harmful.

Thermal Burn

Complaint.—"Sore mouth" "Burned mouth."

Symptoms.—Often due to hot fluids having burned the mouth. Generally affects tongue and palate. Desquamation of tissue in severe burns.

Treatment.—1. Apply anesthetic dental ointment (Butyn 4 percent, Metaphen 1:1500) to tender areas for relief of pain.

2. Paint a 1 percent aqueous solution of gentian (crystal) violet to the area twice daily to reduce chances of secondary infection.

SERIOUS DENTAL INFECTIONS

Infections of the mouth, teeth, or supporting structures can spread to and seriously affect far removed regions of the body. Any evidences of swelling about the jaws and neck area, particularly if accompanied by fever and malaise, should receive prompt professional treatment. Antibiotics and chemotherapy in adequate dosage, bed rest and substantial diet should be applied. Consideration should be given to immediate transfer of the patient for definitive treatment.

Cellulitis, Peritonsillar Abscess, Ludwig's Angina, Acute Osteomyelitis or Cavernous Sinus Thrombosis

Complaint.—"Swollen jaw."

Symptoms.—Rapid swelling over the side of the face to the neck if cause is of mandibular origin (fig. 164). If the cause is of maxillary origin the swelling may extend to the eye (fig. 165). Skin pits on pressure. Becomes red as inflammation localizes. Pain severe, ranging from acute and sharp to throbbing. Temperature may be elevated to 105° F. Rapid pulse. Trismus. Often associated with pericoronitis, periapical or periodontal abscess.

Figure 164.—Serious Dental Infections of mandibular (lower jaw) origin result in extensive swelling over side of face and neck.

Figure 165.—Serious Dental Infections of maxillary (upper jaw) origin result in extensive swelling over side of face to the eyes.

Treatment.—1. Intramuscular penicillin, crystalline G (300,000 U every 12 to 24 hours).

2. Hot magnesium sulfate dressings to localize infection.

3. Confine to bed.

4. Soft diet.

5. Force fluids.

6. Warm saline mouthwash every hour.

POSTSURGICAL EMERGENCIES

Not uncommon are emergency conditions following tooth removal or other surgical operations within the mouth. Secondary hemorrhage may result from trauma, blood dyscrasia, infection, irritation by foreign elements, malignancies, or an absence of normal clotting elements. Pain can be expected to accompany even the simplest of tooth extractions since tissue and bone are traumatized as a result of the operation.

Primary Hemorrhage

Complaint.—"Bleeding from tooth socket."

Symptoms.—History of recent extraction one or more hours previously. Little or no pain. Some soreness in area. Large clots of blood.

Treatment.—1. Gently remove large clots with blunt-nose forceps.

2. Insert 2-inch gauze pad directly to area and have patient close with firm pressure for 10 to 15 minutes. Use as many gauze pads as necessary to provide the necessary pressure.

3. Advise patient to be cautious about any physical exertion for a few days.

4. Repeat treatment frequently if necessary.

5. Advise no mouth rinses.

Secondary Hemorrhage

Complaint.—"Bleeding from tooth socket."

Symptoms.—History of tooth extraction one or more *days* previously. May be pain.

Treatment.—1. Analgesic for pain (APC, 5 grains, prn).

2. Gently remove large clots with blunt-nose forceps.

3. Soak 2 by 2-inch gauze pad in epinephrine (1:1000), and have patient bite firmly thereon as above.

4. Bed rest with head in slightly elevated position.

Sequestra

Complaint.—"Sharp points in area of recent extraction."

Symptoms.—History of recent extraction. Cheek or tongue in adjacent area may be irritated. Sharp bone spicule(s) may protrude through gum tissue. Spicule may be loose or fixed.

Treatment.—1. Apply antiseptic to area (metaphen tincture.)

2. If bone spicule is loose, gently remove with cotton pliers or hemostat.

3. If bleeding results, treat as primary hemorrhage by having patient bite on gauze pad for 5 to 10 minutes.

Dry Socket

Complaint.—"Pain in tooth socket," "Pain in side of face," "Bad odor from socket."

Symptoms.—History of recent tooth extraction—3 to 5 days. Severe pain. If clot normally found in socket is absent, bare bone will be visible. Food debris sometimes fills the socket. If any portion of a clot is present, it appears fragmented and discolored (dark). Bad breath.

Treatment.—1. Irrigate socket with warm water or saline solution (fig. 167).

2. Gently dry socket with cotton pellets, then carefully insert into socket a strip of iodoform

Figure 166.—Dry Socket following extraction of tooth. In absence of debris or discolored clot, bone of alveolus or socket exposed.

Figure 167.—Socket flushed gently with warm saline solution.

gauze moistened with eugenol. Fill socket but do not pack (fig. 168).

3. Analgesic for pain (APC, 5 grains, prn, or codeine, ½ grain, prn).

4. Repeat treatment daily until patient can be seen by a Dental officer.

Figure 168.—Iodoform gauze dressing moistened with eugenol is gently placed in dried socket. It must be changed every 24 hours. Fill socket but do NOT pack.

TUMORS

Tumors are rarely painful in their earlier stages so they will seldom be encountered in first aid treatment. For any condition which doesn't respond to treatment within 48 hours make immediate arrangements for an early examination by a dental officer.

OTHER DENTAL CONDITIONS

Included in this section are a few oral conditions which are seldom painful unless complicated by trauma or infection. The history associated with these conditions may be of long or short duration. The history may be obscure since the patient may have noted presence of the condition by accident only after it had been traumatized. Generally speaking, palliative treatment only is indicated for this category until patient can be referred to a dental officer for consultation and/or treatment.

Hairy Tongue (Black tongue)

Complaint.—"Tongue is black."

Symptoms.—History of long or short duration. Not associated with food or medicant ingestion. Non-painful. Surface stained light brown to black. Surface has a furlike coat which frequently tickles the palate.

Treatment.—1. Three percent hydrogen peroxide painted on tongue surface may remove much of the discoloration.

Obstructive Salivary Calculus

Complaint.—"Swollen jaw."

Symptoms.—Swelling of face in front of ear or below mandible. At mealtime swelling enlarges and is painful. Swelling gradually reduces after the meal. May result in an infection of salivary duct and gland.

Treatment.—1. Have patient observe strict oral hygiene.

2. If swelling persists, use frequent hot saline mouthwashes.

3. If infection is present, characterized by high fever, administer antipyretic (aspirin, 5 grains, q 4 h).

4. Apply antibiotics.

5. Analgesics for pain, if necessary.

6. Inject penicillin (crystalline G) 300,000 units intramuscularly q 12 or 24 h).

Geographic Tongue

Complaint.—"Red patches on tongue."

Symptoms.—History of condition is indefinite. Patient may have noticed condition only recently. Tongue papillae in red areas appear absent. Non-painful except upon ingestion of specific foods known to patient. Ask patient to watch for change in position and size of reddened and irregularly shaped zones.

Treatment.—1. No treatment.

2. Patient should avoid irritating foods.

Torus Palatinus

Complaint.—"Lump on roof of mouth."

Symptoms.—History of being present for many years or patient may have noticed condition only recently. Shape is round to irregular and is found in midline of hard palate. Feels hard and bonelike. No inflammation present unless injured by toothbrush or other foreign object. Non-painful.

Treatment.—1. No treatment.

2. Reassure patient, but have dental officer confirm diagnosis.

3. If bruised or irritated, treat locally with tincture of benzoin compound.

Figure 169.—Torus Palatinus. Round or irregularly shaped bony lump at midline of palate. Does not change shape or enlarge. No associated complaint unless mucosa is traumatized.

Torus Mandibularis

Complaint.—"Lump(s) on inside of jawbone."

Symptoms.—History same as for Torus Palatinus. Shape is round or oblong. Found protruding from jaw toward tongue on each side.

Treatment.—1. Same as above.

Figure 170.—Torus Mandibularis. Similar to Torus Palatinus but found on inside of lower jaw as illustrated.

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Chapter IV

NURSING AND NURSING PROCEDURES[1]

ORIENTATION TO NURSING AND NURSING PROCEDURES—UNIT I

The scope of the material presented in the nursing section is limited to those activities which the corpsman will most likely encounter in a sick bay or hospital ward. It is further limited to the "how" and "what" to do and the reader is referred to other sections of the handbook for the "whys." In this manner it is hoped that the corpsman will more readily see the relationship of the sciences to the care of his patients and the relationships of sections to one another and thus obtain the maximum benefit and use from this handbook.

Objectives.—This section of the handbook was compiled with two objectives in mind:

1. To provide the corpsman with a guide to use in the care of his patient.
2. To provide a basis for the standardization of routine nursing procedures in our Naval hospitals.

In attempting to attain both objectives, we have presented the text in the form of procedures wherever possible. The elements of care for all patients are included in detail while the care of patients with specific conditions is omitted or very limited.

Nursing as defined in this handbook is the care given to sick and injured people. Nursing procedures are methods used in giving nursing care to these patients.

The purposes of nursing and nursing procedures are as follows:

1. To maintain, promote, and restore the patient's health.
2. To protect the patient against contracting a new infection, a reinfection, or a new condition.
3. To assist in the cure of the patient's disease or condition. To achieve these purposes it is necessary that the corpsman:

1. Attend to the comfort of the patient.
2. Prevent the spread of infection.
3. Assist with or perform diagnostic and therapeutic procedures as ordered by the doctor.

The Comfort of the Patient

This means attention to the physical and mental comfort of the patient. By attention is meant the accurate observation of the patient's needs and then doing something about them. "Make the patient comfortable" is not ordered by the doctor; it is up to the corpsman. This is the art of nursing. Making the patient physically comfortable includes providing facilities for a clean patient in clean surroundings; frequent change of position employing comfort devices when needed; attention to patient's diet and elimination. Making the patient mentally comfortable includes keeping the ward quiet and cheerful; providing for the patient's rest and relaxation; treating the patient as a person; promoting his confidence in ward personnel, and keeping him contented. Physical and mental comfort depend on each other; both must be considered and remembered when planning a patient's care.

Prevent the Spread of Infection

The patient comes to the hospital or sick bay expecting to be relieved of his complaints. Everything done for the patient must be directed toward relieving his complaints without exposing him to a new condition or disease. All people are possible carriers and all people are possible victims of disease caused by living organisms. Remember that! You are people! That is the reason why you are urged to get enough sleep and rest, why you are told to keep your body and clothes clean, and why washing your hands will be stressed throughout this section.

The comfort of the patient and the prevention of the spread of infection are measures required by

[1] Much of the material in this chapter was compiled from the lecture notes and lesson plans of former and present Nurse Corps members of the faculties of the Naval Hospital Corps Schools.

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Figure 171.—The Doctor—Nurse—Corpsman Team.

and for all patients and therefore are referred to as "Basic nursing care."

Assist With or Perform Diagnostic and Therapeutic Procedures

All diagnostic and therapeutic procedures are prescribed by the doctor for each individual patient. In following the techniques of a procedure as outlined in this section, try to remember your patient is a person and adapt the procedure to his needs.

CORPSMAN-NURSE-DOCTOR RELATIONSHIP

This is a team. The officer-enlisted personnel relationship exists because the patient requires care. Therefore the primary function of the team is the care of the patient within the limit set by higher authority.

The doctor is the captain of the team. He gives the orders and expects them to be carired out. He is responsible to the chief of his service for the care and treatment of his patients, the efficient operation of the ward, and the coordination of ward activities with other departments of the hospital.

The nurse is the quarterback of the team. She determines how the doctor's orders are to be executed. She is responsible to the doctor and senior nurse for the nursing care of her patients, the management of the ward, and the supervision and instruction of the corpsman.

The corpsman is the halfback of the team. He carries out the orders of the doctor in the manner designated by the nurse. He is responsible to the doctor and the nurse for the efficient care of his patients and for carrying out his assigned duties.

As on any team, there must be mutual respect, cooperation, coordination, and loyalty among team members. Each must appreciate and understand the other's role in the function of the team. When each member of the team knows where he fits on the team, what he is to do on the team, to whom he is responsible on the team, and how he is to do his part on the team, all members take personal responsibility for the team's product which is provision of the best possible care to, and for the patient.

CORPSMAN-PATIENT RELATIONSHIP

The corpsman is in close contact with the patient throughout his stay in the hospital or sick bay. The patient frequently first makes known his wants, worries, fears, and pains to the corpsman. The tact, kindness, consideration, and understanding the corpsman shows toward the patient and his problems will help build the patient's confidence in the ability of all sick bay and hospital personnel to return him to health and duty in the shortest possible time.

The behavior of the corpsman toward his patients should be—

Friendly to all—be familiar with none.
Sympathetic to all—show pity to none.
Assuring to all—discouraging to none.
Efficient in all things—be bungling in none.
Fair and honest to all—show favoritism to none.
Calm always—flustered never.
Self-controlled always—flighty never.
Soft-spoken always—boisterous never.
Interested always—indifferent never.

Suggested Additional Reading—Unit I

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RENDER, HELENA, *Nurse-Patient Relationship in Psychiatry.* New York: McGraw-Hill Book Company, Inc. 1947.

BASIC NURSING CARE—UNIT II

Basic nursing care as considered in this handbook consists of those environmental, hygienic, and supportive measures required by the patient for the promotion of his health and his protection against contracting any additional infection, disease, and/or condition.

The amount of care needed by the patient will vary with each individual. Some patients will need complete care by the nursing personnel; some will need assistance with their own care while others will require only supervision and direction by the nursing personnel.

Points to think about, to know and to practice when caring for your patient:

1. Be an example of good health. Be clean, look clean, feel clean. Use good posture and body mechanics in performing activities for your patient for you may teach your patient good health habits while he is ill which, if practiced, will help him keep well after he leaves your care.

2. Get to know your patient: how does he feel about his illness? His treatment? Other patients? Ward personnel? Find out what makes him "tick."

3. Be alert and observant. Learn to recognize signs and symptoms, be alert to changes in the mental and physical condition of your patient. Use your eyes, ears, nose, and hands. Read and understand the doctor's orders; if in doubt, consult the doctor or nurse.

4. Be adaptable. Learn to adjust nursing care to fit the individual needs of the patient.

5. Be skillful. Learn the routines of procedures so that they may be done with the least discomfort to your patient.

6. Know the "why" of what you are doing. Make frequent reference to other parts of this handbook to better understand the reasons underlying the "how."

7. Have a plan. Use your head to save your feet. Think out what you want to do, how much time you have to do it in, and the method or sequence of doing it. Examine your plan: Is it safe for your patient? Will it be comfortable or add to the comfort of your patient? Is it the best way to save time, materials, and produce the desired effects or results? Will your plan make it possible for you to do the best job you are capable of doing?

8. Explain your plans to your patient. Tell him what you are going to do for him and how he may help to get the best results from the procedure.

9. Protect your patient and yourself.

Use equipment that is in good working condition.

Keep yourself, your patient and the ward clean.

Wash your hands before and after each task.

Consider all body discharges and excreta as possible disease carriers and handle them as such.

Keep your patient's personal belongings within his unit.

Use only clean utensils in caring for your patient; clean, sterilize or disinfect utensils after he uses them.

Provide paper wipes and bags for patients having nose and throat discharges.

Follow medical aseptic technique in the care of a patient with a communicable disease and surgical aseptic technique in the case of a patient with a surgical condition.

Teach your patient the importance of:

Personal cleanliness, particularly washing his hands.

Covering his mouth and nose when he coughs or sneezes.

Using only his own toilet articles.

Getting the proper rest.

Eating the proper diet.

10. Grow in your job. Analyze your work each day—strive to do a better job each day.

THE PATIENT'S ENVIRONMENT

Review—Chapter VI, "Group Protection Against Disease"

The ward is a unit of a hospital composed of a number of beds and other equipment necessary to provide service to and for the patients assigned to it. The ward may accommodate from 6 to 60 patients at one time and should provide a pleasant cheerful environment for the patients and personnel. The ward should be orderly—a place for everything and everything in its place.

Appearance of the Ward

Beds should be in a straight line, away from walls with casters turned in, made up as for standard beds (see "Bedmaking") and spaced at 8-foot center intervals.

Bedside lockers should be on the right side of beds even with head of beds and clear of all unnecessary articles.

Bedside chairs should be in a straight line near foot of beds on same side as lockers.

Overbed tables should be at the foot of the beds.

Window shades should be at uniform height and sills cleared of all articles.

Decks should be clear, shoes and slippers inside bedside lockers.

Waste baskets kept empty; other furniture arranged in orderly fashion.

Hygiene of the Ward

Ventilation.—Provide for free circulation of air—protect patients from drafts by use of ventilators or screens.

Temperature.—Maintain constant and proper temperatures during day, 68° (72°–75° during bath time), 65° at night.

Lighting.—Avoid glaring lights in patient's eyes; promptly replace burned-out bulbs.

Odors.—Keep at minimum by prompt disposal of excreta, dressings, trash. Use deodorants if necessary.

Noise.—Avoid dropping and banging equipment and loud talking and laughing; wear rubber heels on shoes.

Have a systematic routine for cleaning. See "Cleaning Schedule."

The Patient's Unit on the Ward

The patient's unit should be a clean, comfortable place for the patient to live. While he is under your care he will spend the greater part of his time in his unit. He will need a comfortable bed, a bedside locker for his personal gear, and a chair for himself or his visitors.

Cleaning a Bedside Unit

Purpose.—To insure a clean, sanitary bed for the patient.

Indicated.—Once a week for all units; upon patient's discharge; whenever presence of vermin is suspected.

Equipment.—Basin of warm soapy water; sand soap or powder; cleaning cloths; whisk broom; newspaper.

Stripping the Bed

1. Push bedside locker to back of bed; place chair at foot of bed.
2. Remove pillows, strip, and place on chair, linen between rungs at foot of bed.
3. Lift mattress with one hand; pull out linen with other hand. Loosen bedding all around bed.
4. Remove spread, sheets, mattress cover separately, and place between rungs.
5. Remove blanket and rubber sheet and place over back of chair.
6. Take soiled linen (blanket if soiled) to laundry hamper.
7. Remove all articles from the bedside locker. Articles to be boiled may be sterilized while the unit is being cleaned. See Care of Equipment.

Cleaning Unit

1. Place cleaning equipment on top of locker.
2. Spread newspaper on deck under bed.
3. Swing mattress crosswise to lower half of bed.
4. With damp brush or damp cloth, brush top and nearest side of mattress. Pay particular attention to tufts and crevices.
5. Raise the headrest of the Gatch bed. With damp cloth wash springs, coils, bed frame; follow with dry cloth.
6. Lower headrest. Turn mattress clean side down onto the upper half of the bed. Brush mattress.

Figure 172.—Cleaning a Bedside Unit.

7. Place rubber sheet on springs, wash with damp cloth and dry. Turn onto mattress clean side down and wash other side.
8. Place pillows on springs, brush with damp brush, and turn onto mattress clean side down; do other side. Place blanket over head of bed.
9. Wash lower springs, coils, bed frame as before. With damp cloth wash chair; dry well.
10. Place cleaning equipment on newspaper on deck.
11. Wash locker inside and outside; dry well.
12. Use sand soap if necessary for enamel surfaces.
13. Take equipment to utility room. Scour cleaning basin, place in sterilizer, boil 20 minutes; wash out cleaning cloths, and hang up to dry.
14. Swab deck. If in room; swab, wax, and buff deck.
15. Remake bed; square away unit.
16. Wherever possible allow unit to air 6 to 24 hours before remaking bed.

BED AND BUNK MAKING

Bed in the hospital.—The hospital bed is higher and narrower than the bed in the barracks. The purpose is to bring it up to a better working level and thus reduce fatigue and avoid backstrain for the personnel caring for the patient.

The bed with a Gatch frame is the fundamental device for making the patient comfortable. The crank-operated Gatch frame permits raising and lowering of the head and foot; the newer frames may be adjusted to many different positions and

have attachments to support fluid containers, orthopedic apparatus, and sidebars. The legs of the bed have rubber tired wheels to make them movable and are equipped with brakes to make them stationary. The mattress in most naval hospitals is of the inner spring type and should be firm, even, and clean. The bedding under the patient should be smooth and tight. The upper bedding should be loose, of light weight, draped evenly, and of sufficient warmth and length to keep the patient comfortably warm.

The bunk aboard ship.—The bunk aboard ship is narrower than the hospital bed and may not have a Gatch frame. The head or foot of the bunk may be raised by inserting a board under the mattress.

BED AND BUNK MAKING PROCEDURE (UNOCCUPIED)

Purposes:

To provide a clean, warm, sanitary bed or bunk to receive a patient.

To provide a neat, uniform appearance to a ward or sick bay.

Equipment:

1 mattress cover
2 sheets
1 blanket
1 spread
1 pillow case
1 pillow cover
1 pillow

When additional protection of the mattress is desired, add:

1 rubber draw sheet
1 cotton draw sheet

RECOVERY BED

Postoperative or Ether Bed

Purpose:

To provide a warm, comfortable bed for the postoperative patient.

To protect the mattress.

Equipment:

In addition to the equipment listed for the unoccupied bed:

Small rubber sheet
Cotton sheet
Paper bag and safety pin
3 hot water bottles*

For the bedside locker (176):

Curved basin
Box tissues
Clock with a second hand
Pencil and paper
Sphygmomanometer
Stethoscope
Padded tongue depressor
Bandage

Procedure:

1. Make the bottom or foundation bed as directed in "bed making."
2. Place the small rubber sheet over the bottom sheet at the head of the bed. Fold the cotton sheet in quarters; cover the rubber sheet. Tuck in both sheets at sides.
3. Open top sheet on bed, smooth side down, center fold down center of bed, hem even with top of mattress.
4. Open blanket on bed, center fold down center of bed, 6 inches from the top of the mattress.
5. Open spread on bed, center fold down center of bed, smooth side up, hem even with top of mattress.
6. Fold spread over blanket, sheet over spread at the head of the bed.
7. Fold sheet over the spread and blanket at foot of bed.
8. Tuck in top bedding along the side away from the entrance.
9. Fold top bedding up onto bed on the side nearest the entrance.
10. Fit pillow into cover and case; place between rungs at the head of the bed.
11. Pin paper bag to side of mattress at the head of bed.
12. Arrange equipment on bedside locker as illustrated.
13. Push locker to back of bed.

*The practice of placing hot water bottles in a recovery bed is gradually falling into disuse. It is recommended that hot-water bottles be included only when the bed is prepared for a patient in poor physical condition; for a patient subjected to extremes in temperature in traveling to and from the operating room; and when ordered by the doctor or nursing supervisor. If hot-water bottles are used, place them in the bed under the top cover as illustrated (fig. 177). **Be sure to remove hotwater bottles before putting patient to bed.**

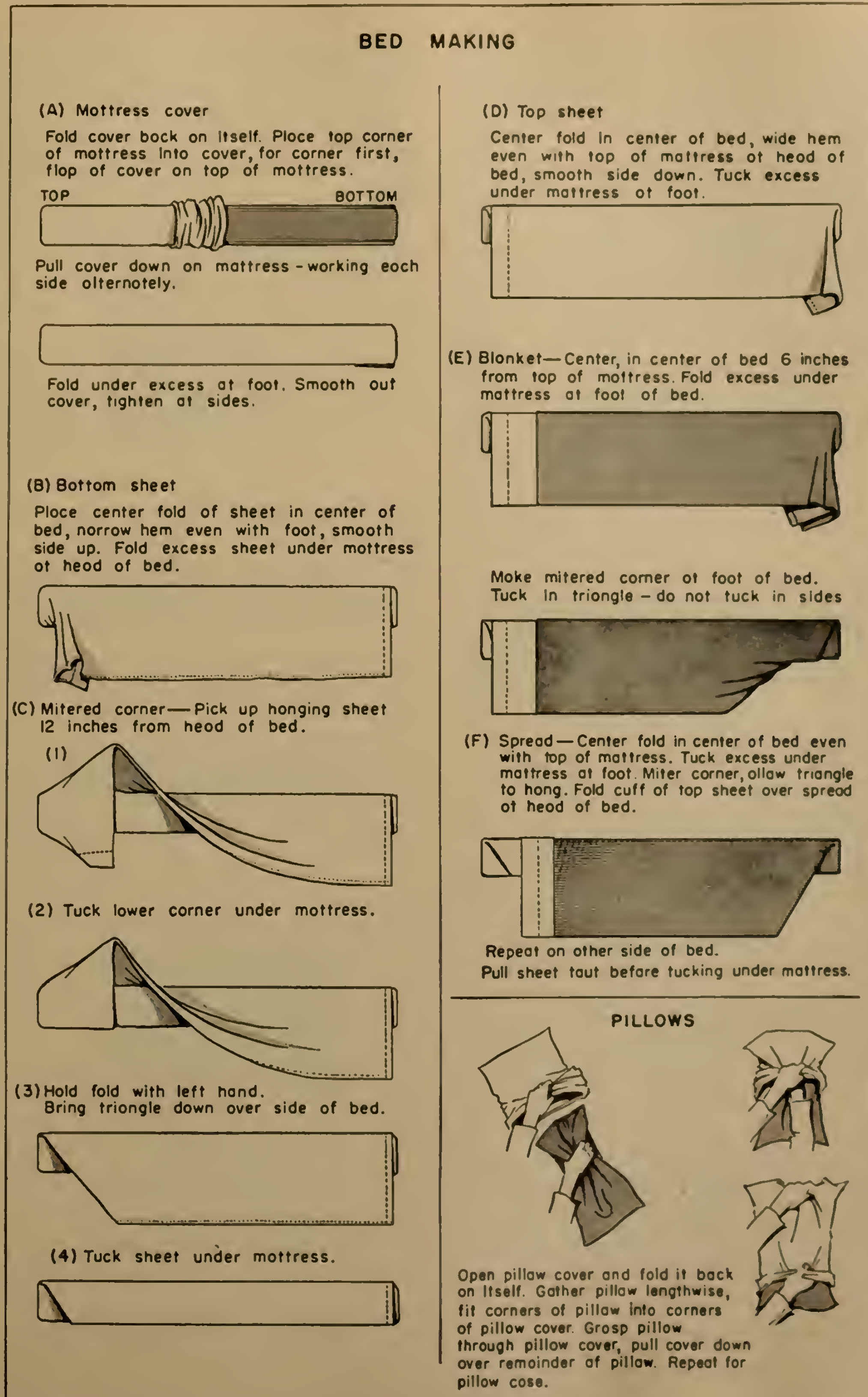

Figure 173.—Bed Making.

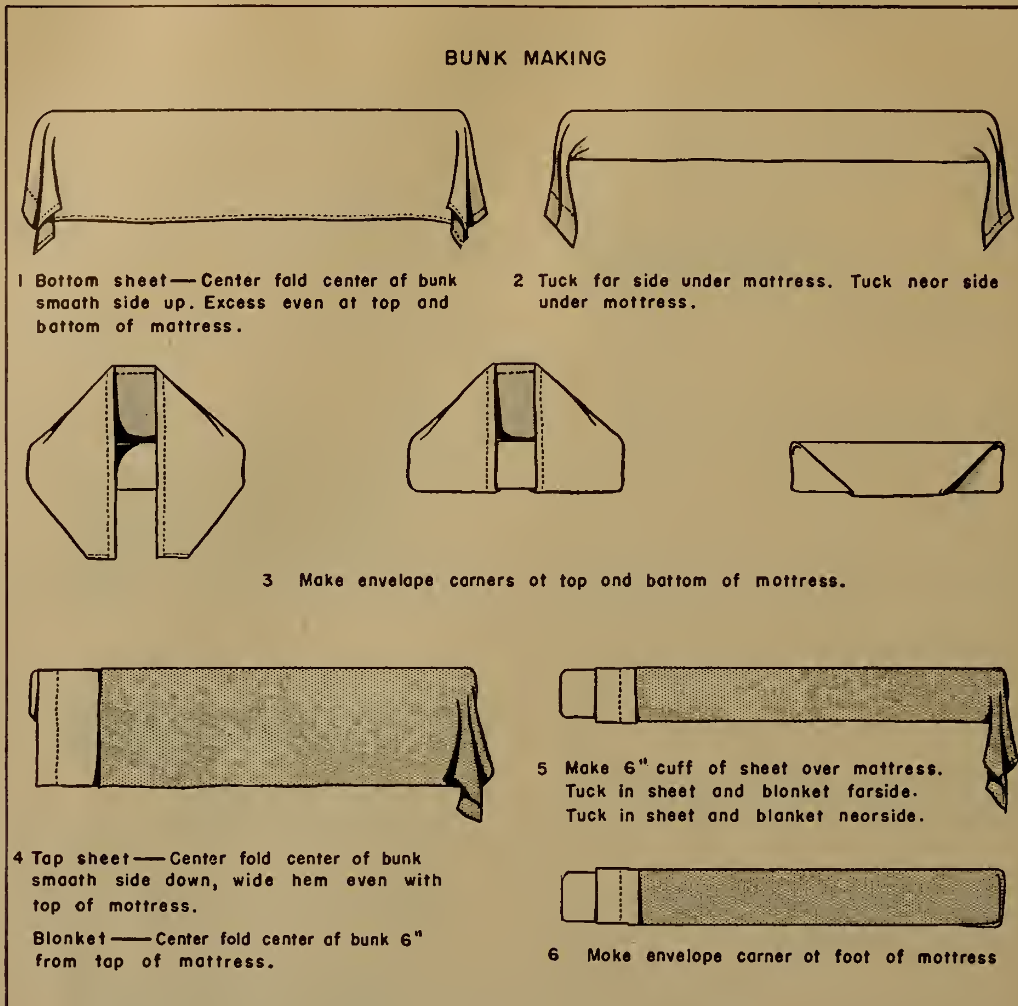

Figure 174.—Bunk Making.

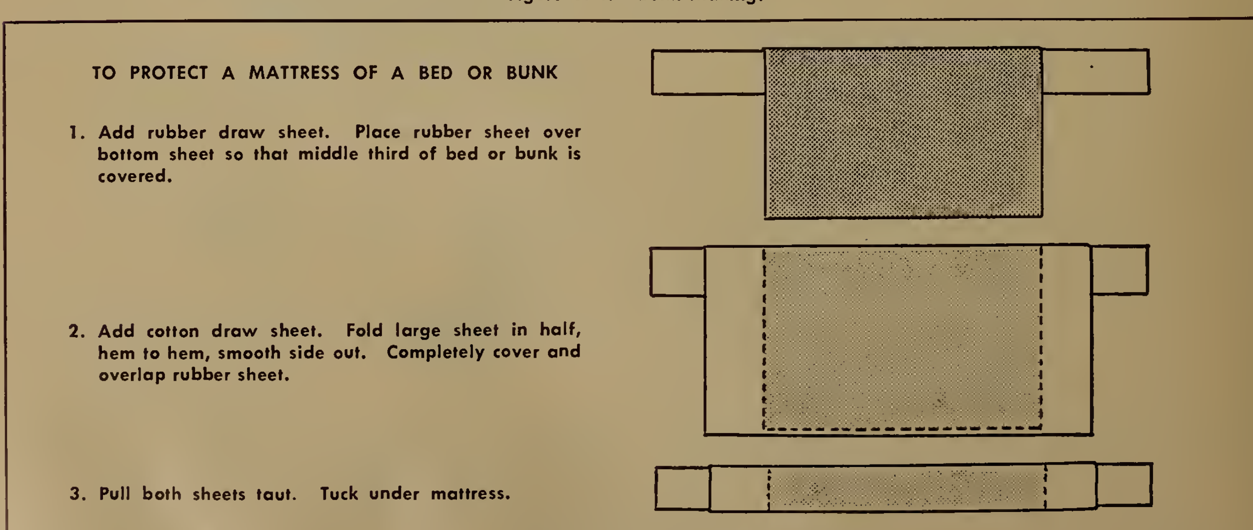

Figure 175.—To Protect Mattress of a Bed or Bunk.

Figure 176.—The Recovery Bed.

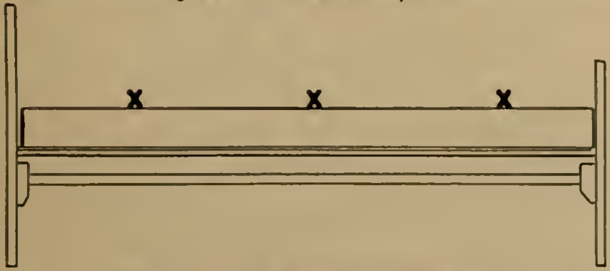

Figure 177.—Hot Water Bottle Placement.

Figure 178.—Changing the Bottom Sheet.

TO MAKE A BED WITH A PATIENT IN IT (OCCUPIED BED)

Purpose.—To provide clean bedding with least exertion to patient.

Equipment.—Linen as needed.

Procedure:

1. Place chair at foot of bed; push bedside locker back of bed.
2. Loosen all bedding at sides and foot of bed.
3. Remove pillow, strip case, and place on chair.
4. Remove spread in quarters, fold from top to bottom, pick up in center, and place on back of chair.
5. Remove blanket in same manner.
6. Turn patient to one side of bed.

To change bottom sheet, draw sheet:

1. Roll draw sheet close to patient's back.
2. Fold rubber sheet up over patient.
3. Roll bottom sheet close to patient's back.
4. Place clean sheet on bed, center fold in center of bed, smooth side up, narrow hem even with foot of mattress.
5. Tuck in excess at head of bed, miter corner, and tuck in at side.
6. Bring down rubber sheet; straighten.
7. Fold large sheet in half, hem to hem, smooth side out.
8. Place on bed, fold toward head of bed, overlapping rubber sheet.
9. Tuck in rubber and draw sheets together.
10. Roll patient over to completed side of bed, toward you.
11. Remove wrinkles from under patient.
12. Go to other side, fold in soiled sheets, remove, and place in rungs at foot of bed.
13. Turn back draw and rubber sheets over patient.
14. Pull bottom sheet tight and smooth; proceed as for first side.
15. Pull rubber and draw sheets tight; tuck under mattress. Do center portion first, then upper and lower ends.
16. Bring patient to center of bed.

Top bedding:

1. Place top sheet over patient, smooth side down, wide hem even with top of mattress; turn down to make 10 inch cuff.
2. Ask patient to hold clean sheet.
3. Reach under, grasp soiled sheet, remove, and place in rungs at foot of bed.
4. Place blanket 6 inches from top of mattress; "Medical Department" should be readable from foot of bed.

5. Make pleat in sheet and blanket over patient's toes, tuck in excess at foot, and miter corner.

6. Place spread smooth side up even with head of bed; "Medical Department Insignia" should be readable from foot of bed.

7. Fold spread over blanket; fold sheet over spread at head of bed.

8. Tuck in excess foot, miter corner, and allow triangle to hang loosely.

9. Fit pillow into corners of case; place under patient's head, seam toward back, closed end toward entrance to ward.

10. Adjust bed Gatch as ordered.

11. Straighten unit; leave bedside stand within reach of patient.

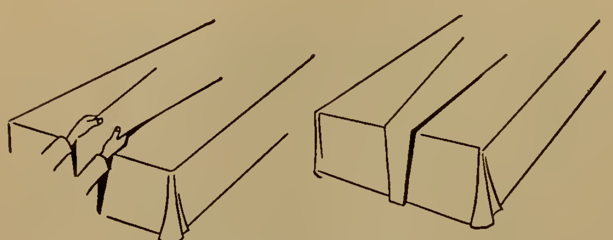

Figure 179.—Tce Pleat.

Modifications:

1. Top sheet may be used as draw sheet. Change top sheet first; then fold for draw sheet. Proceed as above.

2. Spread may be too short. Make foot of bed; then fold excess, if any, over blanket.

BUNK ABOARD SHIP (THE OCCUPIED)

The bunk aboard ship is made in the same manner, with the following exceptions:

1. The patient is turned toward the corpsman.

2. The side of bunk nearest the bulkhead is completed first; the patient is then turned toward the bulkhead and the other side of the bunk is completed.

3. The top bedding is made with envelope corners at the foot of the bunk.

ADMISSION, TRANSFER, AND DISCHARGE OF PATIENT

Review—Local Station Orders

ADMISSION

Ambulatory patient:

In admission unit:

Greet patient courteously; seat him at desk.

Type out admission card; follow instructions on card.

Seal patient's gear in presence of the patient; send gear to bag room with hospital ticket.

Assist doctor with the physical examination.

Notify ward of patient's admission.

Send patient to ward with—

Completed copy of admission card NavMed 1285.

History sheets I and II—Forms 504 and 505.

Physical examination—Form 506.

In ward:

Greet patient courteously, introduce yourself, and seat him at desk.

Take patient's temperature, pulse, and respiration; blood pressure; height and weight. (If patient's temperature is 100° or over, put him to bed immediately.)

Find out his chief complaints, other objective and subjective symptoms.

Have patient read the hospital regulations and the ward routine.

Assign patient his bed; provide towels and pajamas; introduce him to his neighbors. Instruct and supervise patient's tub bath or shower.

Notify doctor of admission.

Start patient's chart:

Fill out chart headings.

Graph temperature, pulse and respiration on Form 511.

Start nursing notes—date, time, manner of admission, his chief complaints, and objective symptoms.

Enter patient's name and other necessary information in—

TPR book.
Ward report (Nav Med HF9).
Diet list.
Ward report book.

Insert admission card in ward roster.

Make out bed tag; place in holder at foot of bed.

Stretcher patient

Admission unit:

If patient is able to give information and is not seriously ill, follow instructions as for ambulatory patient.

If patient is seriously ill or unable to give information—

1. Provide necessary emergency measures prescribed by the doctor and send patient to ward as soon as possible.
2. Obtain information for admission card from person accompanying the patient.
3. Seal and send patient's gear to bag room with hospital ticket. Send receipt for clothes with valuables to the disbursing officer or officer of the day.

On ward

Put patient to bed immediately.

Notify ward doctor and carry out emergency measures needed.

Take patient's temperature, pulse, respiration, and blood pressure.

Start chart.

If patient's condition permits and does not interfere with treatment, give bed bath. Note rashes, scars, sores, reddened areas, or lice.

Patient in wheel chair or child in arms:

1. In admission unit: carry out procedure as for ambulatory patient.
2. On ward: put patient to bed; follow procedure as for ambulatory patient; include bed bath.

TRANSFER OF PATIENT

Admitted from other Ward (AOW)

Receiving ward:

1. Have bed ready for the patient.
2. Receive patient and his records.
3. Assign patient to his bed; introduce him to his neighbors.
4. Have patient read ward routine affecting him.
5. Notify doctor of new admission.
6. Record "AOW" in Ward Report Book; Ward Report; patient's chart.
7. Enter patient's name in TPR book, diet list.
8. Place admission card in ward roster, bed tag on bed.

Transferred to other Ward (TOW)

Transferring ward:

1. Make out TOW slips—send copies to—
   Receiving ward with patient.
   Personnel office.
   Chief of service.
   Officer of the day.
   Post office.
2. Notify receiving ward. Do not transfer patients at mealtimes, visiting hours, or during sick call.
3. Send patient to receiving ward with his gear, chart, and admission card.
4. Enter as "TOW" in Ward Report Book, Ward Report (Nav Med HF9).
5. Remove name from TPR book, diet list.
6. Notify diet kitchen.

Transferred to another hospital:

Carry out procedure as for discharge to duty.

DISCHARGE OF PATIENT

Discharge to Duty "D"

Before discharge (may be 24 to 48 hours. See "Station orders").

Close out patient's chart; arrange pages in numerical order; attach discharge slip to top page.

Send complete chart to record office.

Day of discharge:

Have patient strip his bed and clean and make up his unit if he is able.

Check out slip.

Check those places listed from which the patient must have clearance.

Tell patient to obtain initials of persons in these places and to leave check-out slip at record office for inclusion in his chart.

Ward records:

List patient's name as discharged in Ward Report Book and Ward Report.

Remove patient's name from all other ward records.

Discharge by Death "DD"

(See "Care of the Dead"):

Arrange patient's charts in numerical order; attach admission card to chart.

Send complete chart to record office.

Follow routine for ward records as above, using "DD."

Clean bedside unit.

CARE OF CLOTHING AND VALUABLES

Purpose.—To safeguard patient's gear; to safeguard personnel handling patient's gear; to simplify procedure for care of patient's clothes.

Equipment.—Metal seals (Stock No. 42–5–2135–200); Personal Effects Tag (NAVMED–HF–22); pencil or pen.

Procedure.—On admission.

In admission unit:

Seal patient's gear with metal seal in presence of patient. Permit only essentials [5] to go to the ward.

Enter number of seal on top and stub portions of Personal Effects Tag. Attach top to baggage.

Give patient stub.

Send gear to bag room.

If patient wishes and provides a lock, make a note to that effect on reverse side of effects tag.

In bag room:

Assign bin or rack to patient's gear.

Post number of bin or rack on Baggage Record Card (NAVMED–HF–25).

File record card in alphabetical order.

Store gear in assigned place.

During Hospital Stay

1. Care of patient's gear **on ward.** (See "Station orders.")

Toilet articles and small bag may be kept in bedside locker.

Uniform may be placed in the ward clothes locker.

The clothes locker must be kept locked except when one of the ward personnel is present.

Deposit and withdrawal system similar to that in use in the bag room should be maintained.

Establishment of regular hours for deposit and withdrawal from ward clothes locker is suggested.

2. Deposit or withdrawal **from bag room** during hospital stay.

Ambulatory patient:

Patient will break seal and deposit or withdraw the desired items in the presence of the bag room attendant.

The bag room attendant will make a note of the deposit or withdrawal on the Bagggage Record Card. Patient will sign note.

The bag room attendant will draw a line through the broken seal numbers on the record card and stub of Personal Effects Tag; attach new seals to the gear, and enter new seal numbers on the record card and stub of Personal Effects Tag; give the patient a copy of the new seal number(s).

Bed patient:

The ward medical officer or nurse will sign a memorandum designating a corpsman to withdraw or deposit items for a bed patient.

The bag room attendant will follow same procedure as above in resealing gear.

The memorandum will be attached to the Baggage Record Card.

On Discharge

1. Patient will report to bag room on day of discharge with check-out slip.

2. Bag room attendant will sign check-out slip and will staple Personal Effects Tag to Baggage Record Card.

3. Bag room attendant will forward cards to record office for inclusion in patient's chart.

CARE OF VALUABLES

All patients must be informed of the wisdom of depositing their valuables with the disbursing of-

[5] Essentials are toilet articles, stationery, uniform (1), and underwear. All other gear must be sent to bagroom. Bags containing articles for bedside use must be small enough to fit inside bedside lockers.

ficer for safekeeping. Patient must be made to understand that no responsibility is assumed by the hospital if he retains his valuables at his bedside. A signed statement by the patient should be included in his chart if he insists. Temporary storage of valuables in the narcotic locker of the ward medicine locker is prohibited.

Valuables are deposited for safekeeping:

1. With the disbursing officer during the day (Ex: 0800–1600).
2. With the officer of the day during the evening and night (Ex: 1600–0800).

Ambulatory patient:

1. Send the patient to the disbursing officer or officer of the day.
2. Patient and officer will inventory valuables.
3. The officer will give the patient a signed receipt.

Bed patient:

1. Valuables will be inventoried by the ward medical or nurse officer and the patient.
2. The officer will give the patient a temporary receipt for his valuables.
3. The officer will take the valuables to the disbursing officer.
4. The patient will be given the disbursing officer's receipt and the temporary one will be torn up and discarded.

Incompetent patient:

1. The ward medical and nurse officers will inventory and deposit valuables with the disbursing officer.
2. The receipt will be placed in the patient's jacket in the personnel office.

OBSERVATION OF THE PATIENT

Review—Chapter II, "The Blood and Blood Vascular System"
"The Respiratory System"
Chapter III, "Emergency Medical Care"
Chapter VII, "Drugs Which Act Upon the Circulatory System"
"Drugs Which Act Upon the Respiratory System"

Observation of the patient is the recognition, recording and reporting of signs and symptoms indicating the mental and physical condition of the patient.

The doctor depends upon the corpsman for accurate recognition, recording and reporting of the patient's condition during the day and night. The corpsman is with the patient most of the time, the doctor only a few moments each day. In these few moments the doctor must use the corpsman's record and his report in deciding whether the patient is doing well under present treatment or whether it should be changed or modified. It is important to be able to recognize even the slightest change in the patient because while the change is slight in itself when combined with other changes it may show a definite disease process which may indicate further treatment.

The recording of observations should be done as soon as possible after they have been made. Do not wait until the end of the day because by that time you may forget a detail which is important in the treatment of your patient. Use medical terminology in your recording but if you are in doubt as to the correct term, use plain everyday English.

The reporting of observations should be made immediately when prompt treatment is required. When reporting, give complete information: patient's name, ward, present diagnosis, T.P.R. the symptoms, its location, duration and severity, and general condition of your patient.

Purposes.—To aid the doctor in making a diagnosis and prescribing treatment for the patient. To determine the effects of a prescribed course of treatment. To modify the nursing care to fit the needs of the patient.

Indicated.—Observation is essential at all times, from the patient's admission until his discharge and particularly during bath and meal times,

while asleep and during treatments and visiting hours.

Signs and symptoms.—Indications of the mental and physical condition of the patient may be classified as objective and subjective symptoms.

Objective symptoms are those which the observer can see—rashes, swelling, inflammation, etc; feel—skin eruptions, masses, changes in pulse, etc.; hear—speech, snorting respirations, etc.; smell—odors.

Subjective symptoms are those which only the patient can feel or describe, such as pain, tenderness, ache, nausea, etc.

Additional signs indicating the condition of the patient may be determined by the use of instruments, examinations and tests; such as thermometers, manometers, X-rays, specimens, etc.

System for observation.—While assisting the doctor with a physical examination, note the systematic way in which he performs his observations. In observing patients note:

General appearance:

Is he short? Stout? Thin? Average?

Does he appear in pain? Ill? Well?

Does he walk normally? With a limp?

Mental condition:

Does he appear delirious? Excited? Depressed? Restless? Unconscious? Happy?

Does he refuse to talk or eat? Does he shout or sing?

Does he appear sullen? Aggressive? Cooperative?

Does he sleep well, poorly? Is he restless in his sleep? Does he moan, groan, or cry out in his sleep?

Position:

Does he stay in one position? On his side or his back? Does he draw his legs up on his abdomen?

Does he have difficulty breathing when he lies down?

Is his neck stiff? Arched backward?

Is he able to move about in bed?

Skin:

Is the skin hot? Cold? Dry? Moist?

Is the skin flushed? Pale? Cyanotic?

Are there any scars? Wounds? Rashes?

Does the skin appear shiny? Stretched? Is there edema present?

Is a pit made when the fingers are pressed into it?

Are there any lice? Nits?

Eyes:

Are the eyelids swollen, bruised or discolored?

Are the whites of the eyes clear? Dull? Yellow? Bloodshot?

Are the pupils contracted? Dilated? Equal in size?

Does he complain of pain? Burning? Too much light?

Ears:

Do the ears appear normal?

Does he seem to hear well?

Does he complain of buzzing or ringing in his ears?

Does he have any discharge from his ears? What kind is it?

Mouth:

Does his tongue appear dry? Moist? Clean? Coated? Cracked? Red? Spotted?

Does he complain of an unpleasant taste? Is there an odor to his breath?

Are his teeth in good repair? Clean? Does he have removable bridges? Dentures?

Does he have any sores in his mouth? Does he complain of any soreness?

Nose:

Does his nose appear to be straight?

Does he appear to have difficulty breathing through his nose?

Is there any nasal discharge present?

Chest:

Are there rattling, snorting or wheezing sounds when he breathes?

Does he have pain or difficulty breathing?

Is he coughing? Is the cough productive? Dry? Hacking? Persistent?

Is sputum expectorated? Is it white? Yellow or rusty? Thick or thin? Large or small amount?

Abdomen, bowels, and bladder:

Is the abdomen distended? Is the distention above or below the umbilicus or over entire abdomen?

Is there a belching of gas?

Is he nauseated?

Is he vomiting? Is there pain and nausea associated with it? How often does he vomit? What does the vomitus look like? Color? Amount? Odor? Contents?

Has he had a bowel movement? When? Is he constipated? Does he have diarrhea? Is he incontinent? What is the color, consistency, amount and odor of the feces? Is there blood or pus? Are there worms?

Does he void sufficiently? Does he void frequently in small amounts? What is the color, odor, and amount of the urine? Is there blood or sediment in the urine? Does he have difficulty passing urine? Is he incontinent?

Pain:

Where is the pain or ache? How severe is it? Is it sharp, dull, aching, knife-like? Is it constant, intermittent? How long has he had it?

Does he assume a special position to relieve the pain?

Has he had a medication for the pain? Has the medication relieved him?

Wounds:

What is the condition of the wound? Is it clean? Is it reddened? Swollen? Painful?

Is there a discharge present? What is its color, odor, and consistency? Is it bloody?

Assisting With a Physical Examination

Purpose.—To aid the doctor in making a diagnosis; to aid the corpsman in planning necessary nursing care.

Equipment.—Tray with:

Diagnostic set (ophthalmoscope, otoscope).
Tongue depressors.
Flashlight.
Stethoscope.
Sphygmomanometer.
Tape measure.
Skin pencil.
Percussion hammer.
Paper bag for used depressors.
Curved basin for specula.
Safety pins.
Rubber gloves or finger cot.
Paper towel.

Procedure of examination:

Preparation of patient [6] and equipment:

1. Place patient in a warm, well-lighted room or screened area.
2. Tell patient what is to be done and how he may help.
3. Undress and cover patient with sheet.
4. Take and record height, weight (place paper towel on scale).
5. Place patient in horizontal position.
6. Have all equipment at hand.

Technique of examination:

1. Doctor will usually examine patient's head first and then proceed to chest, abdomen, extremities and genitalia. As the examination progresses, expose each part of the body.
2. Place patient in proper position for examination desired (fig. 180).

After examination:

1. Make patient comfortable in bed.
2. Strip, clean, reset tray.

Cardinal Symptoms

Temperature, pulse, respiration (TPR) and blood pressure (BP) are called the cardinal symptoms because they give important and vital indications of the condition of the patient. The measurement of these symptoms and their relationship to each other aid the doctor in making a diagnosis and prescribing treatment and may help the corpsman determine the amount and kind of nursing care necessary for his patient.

TEMPERATURE

Temperature is the degree of heat in the body. It is the balance between heat produced and heat lost by the body. When the balance is disturbed, deviations of body temperature result. Deviations above the normal range are called elevations or fever; those below normal range are called subnormal.

Normal temperature.—The normal range is 97° to 99° F. (mouth): 98° to 100° F. (rectum): 96° to 98° F. (axilla). The normal temperature is usually at its lowest point in the early morning and at its highest in the late afternoon.

[6] When female patient is being examined, a female (corpswave or nurse officer) must be present.

SIMS—Used for rectal, vaginal and perineal examinations and treatments

DORSAL RECUMBENT—Used for examination of external genitalia; urethral, vaginal and rectal treatments

DORSAL LITHOTOMY—Used for examination of external genitalia; urethral, vaginal and rectal treatments

SHOCK or TRENDELENBERG—Used in treatment of shock; pelvic and abdominal surgery. Blocks also used for orthopedic patients in traction

LUMBAR PUNCTURE—Used for lumbar puncture. Important—Hips and shoulders must be in the same vertical plane

MODIFIED JACK KNIFE—Used for rectal examination and treatment. Legs may hang down straight

POSTURAL DRAINAGE - GATCH BED—Used to promote drainage from respiratory tract. Patient is placed over knee break of bed

POSTURAL DRAINAGE - STOOL METHOD—Used to promote drainage from respiratory tract

Figure 180.—Positions for Examinations and Treatments.

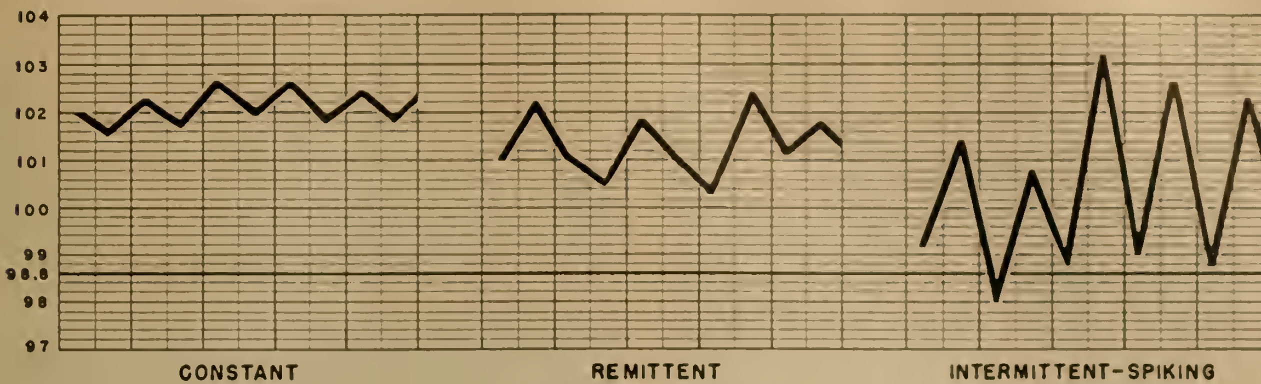

Figure 181.—Types of Fever.

Fever.—Fever may begin suddenly or gradually and its course may be constant, remittent or intermittent.

A constant fever is one in which the temperature remains elevated at about the same level during a period of 24 hours or longer.

A remittent fever is one in which the temperature rises and falls in a moderate range but does not approach normal.

An intermittent fever is one in which the temperature rises and falls in a great range, approaching normal or below in a 24 hour period. Fever may subside in two ways:

1. Suddenly by (CRISIS) in which there is an abrupt drop to normal with dramatic improvement of the patient.

2. Gradually by (LYSIS) in which the return to normal extends over a period of days or weeks.

Subnormal.—Deviations below normal range. Due to shivering mechanism of the body, this type of temperature is not often encountered except in certain periods of extreme illness when the subnormal temperature would indicate body resistance is being overwhelmed. It is also found in many chronically ill, starving, cachectic or emaciated patients.

Taking the temperature.—Body temperature is measured by the clinical thermometer. The thermometer is scaled in the Fahrenheit system and calibrated in $\frac{2}{10}°$.

Routes of measurement are:

1. By mouth which is the easiest and most often used route. The thermometer is left in place 3 minutes.

2. By rectum, which is the most accurate, and is used for children, delirious or unconscious patients,

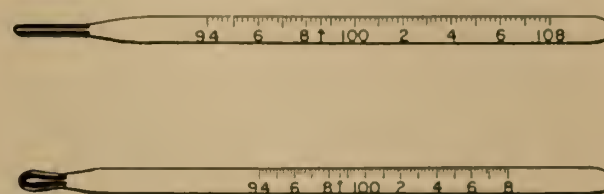

Figure 182.—Types of Thermometers.

and patients who are mouth breathers, who cough frequently, or who have had mouth surgery. The thermometer is held in place 5 minutes.

3. By axilla which is least accurate and used only when mouth and rectal routes cannot be used. The thermometer is held in place 10 minutes.

Shaking down the thermometer

1. Stand in clear space away from bedside table.

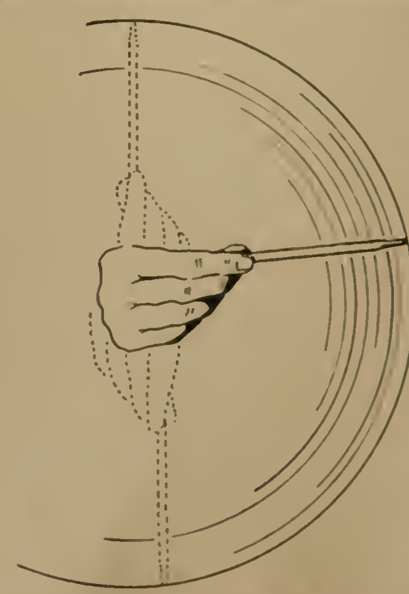

Figure 183.—Shaking Down the Thermometer.

211866°—53——12

2. Hold thermometer firmly at top between thumb and first two fingers.

3. Shake with loose wrist movement as though shaking water off the hand.

4. Shake thermometer down to 95° F.

Reading the thermometer

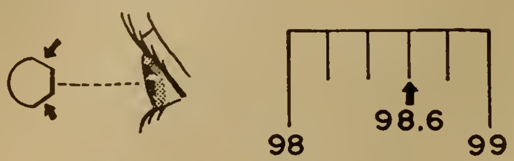

Figure 184.—Reading the Thermometer.

1. Stand in a good light.

2. Hold thermometer at the stem end, ridge side toward you.

3. Read the scale to include the degree and the nearest 2/10 of a degree.

Taking the pulse.—The pulse may be taken wherever an artery lies near the surface of the body or over a bone. The most frequently used site is the radial artery on the thumb side of the wrist. Other arteries which may be used are the temporal (side of the head in front of the ear); the carotid (front side of neck, may often be seen beating); dorsalis pedis (the top of the foot). In the measurement of pulse, the pulse rate (number of beats per minute), the force (strength or weakness of beat), the rhythm (regular or irregular space between beats), and the volume (full or soft) are noted.

The pulse is usually taken at the same time the temperature is taken and whenever the patient shows a change in condition, postoperatively while recovering from anesthesia, when getting out of bed for the first time, and when receiving medications affecting the pulse.

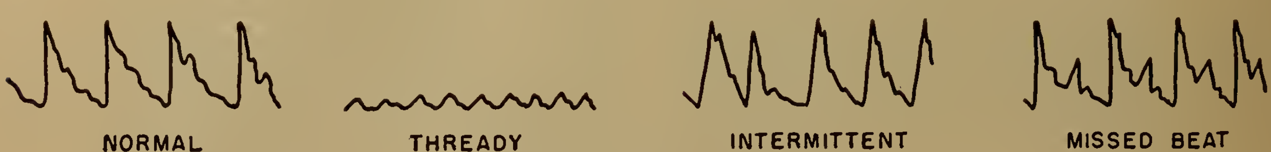

Figure 185.—Variations of Pulse.

PULSE

Pulse is the alternate contraction and dilation of the arteries due to the pumping of the blood by the heart. Changes in the character of the pulse may be due to any factor which interferes with the function of the heart, the volume of the blood, and the elasticity of the blood vessels. Therefore, the measurement of the pulse is a valuable means of learning the condition of the heart, blood vessels, and general condition of the patient.

Normal pulse.—The pulse rate even in good health varies with the individual. The rate is faster in infants and young children, slower in aged persons, faster in women than in men, and is affected by exercise, fatigue, and emotions. The normal range for adult women is 72 to 80; for adult men 62 to 72 pulsations per minute. The pulse rate usually increases 10 beats for each degree rise in temperature. The normal pulse should feel firm, smooth, straight, and elastic under the finger tips and should be regular in rate and rhythm.

Variations of pulse

Normal: Regular rate, rhythm, force, and volume.

Missed beat: Regularly irregular in rhythm and rate; may be irregular in force and volume.

Intermittent: Irregular rhythm and rate; may be irregular in force and volume.

Thready: Rapid, running, difficult to count or to determine quality.

PROCEDURE FOR TAKING AN APICAL-RADIAL PULSE

Purpose.—To compare the pulse rate of the heart (apex) and radial artery.

Equipment.—Stethoscope; watch (with second hand); alcohol sponge.

Procedure

Preparation of patient.

Patient lying quietly in bed.

Open pajama coat; expose chest.

First corpsman [7] on left side of bed.

Place stethoscope in ears, earpieces facing forward.

Locate apical pulse (slightly below and to the right of the left nipple).

Listen to the sounds for a few minutes, until the rate and rhythm are familiar. The sounds will be somewhat like lub-dub, lub-dub; each lub-dub is one beat.

Figure 186.—Taking an Apical—Radial Pulse.

Second corpsman on right side of bed.

Locate radial pulse.

Hold watch so that it can be seen by both corpsmen.

At signal of the one taking the apical pulse, both corpsmen count pulses for 1 minute. Recheck.

Replace pajama coat; leave patient comfortable.

Wipe earpieces of stethoscope with alcohol sponge.

Record on patient's chart in observation column of nursing notes. Use plotting chart if pulses are to be recorded graphically.

RESPIRATION

Respiration is the act of breathing in (inhaling) and breathing out (exhaling) air (oxygen) by the lungs. Oxygen is needed by the body; the act of respiration supplies this need.

[7] Two corpsmen are necessary because these pulses must be taken at the same time to compare the rates.

Normal respiration.—The normal respiration is regular in rate, rhythm, and depth and is performed without pain, strain, or difficulty. The normal rate is rapid in infants and in young children, slow in aged persons; ranges from 16–24 per minute in healthy adults and is affected by age, sex, exercise, sleep, and emotional disturbances. The respiration usually increases 1 to 2 in rate with every 10 beat rise in pulse and each degree rise in temperature. Respirations may be controlled to some extent by the patient and should be counted without his knowledge if possible. Respirations may be counted by watching the rise and fall of the chest, listening to patient's breathing, or feeling the chest move up and down.

Variations of respirations:

Dyspnea—painful, difficult breathing.

Air-hunger—short, gasping breaths followed by a few normal breaths.

Stertorous—loud, snorting breathing.

Edematous—moist sounds as if air is passing through water.

Taking Pulse and Respiration

1. Have patient lie or sit down. Place his arm and hand in a relaxed position, thumb up, supported on a chair arm, table, bed, or placed across his chest.

2. Locate pulse by placing the first 3 fingers (not your thumb) on the thumb side of patient's wrist.

3. Count pulse rate for 30 seconds, multiply by 2, and record as number of beats per minute. Check again, noting the quality (force, rhythm, volume). If any deviation is noted, take pulse for full minute.

4. With fingers still on wrist, count respirations for 30 seconds; multiply by 2 and record as number of respirations per minute. If any deviations are noted count respirations for full minute.

Procedure for Taking Temperature (Oral), Pulse, and Respiration

Purpose.—To determine the degree of temperature, the rate and characteristics of the pulse, and respiration of the patient or group of patients.

Figure 187.—Thermometer Tray.

Equipment [8]

Tray with—

2 covered containers of alcohol 70 percent.

6 thermometers—3 in each container of alcohol.

1 container of water.

1 container of soap solution.

1 container of cotton squares.

1 sputum cup for waste cotton.

1 clock or watch with a second hand.

1 TPR book.

1 pen or pencil.

Figure 189.—Taking the Temperature, Pulse and Respiration.

[8] C. Richard Smith, "Alcohol As a Disinfectant Against the Tubercle Bacillus" (Public Health Reports 62 : 36, September 5, 1947) 1285–1295. Repr. BUMED Newsletter 10 : 8.

Precautions

1. Have the patients lying quietly in beds or sitting down in chairs.
2. Wait for 30 minutes before taking the temperature of a patient who has had a hot or cold drink or has been smoking.
3. Be sure the thermometer is down to 95° F. before placing it in the patient's mouth.
4. Be sure the thermometer is under the patient's tongue.

Procedure

1. Remove a thermometer from the first container of alcohol.
2. With a cotton square and in a rotary motion, wipe the thermometer from bulb to stem.[9] Shake down thermometer to 95° F.
3. Place thermometer under the first patient's tongue; caution him to keep his lips closed.
4. Distribute the other thermometers to the second and third patients in the same manner.
5. Take the pulse and respirations of the third patient. Record in the book.
6. Repeat step 5 for the second and first patient.
7. Remove the thermometer from the first patient's mouth.
8. Moisten cotton square with soap solution; wipe the thermometer from stem to bulb in a rotary motion.
9. Moisten a cotton square with water; wipe the thermometer from stem to bulb in a rotary motion.
10. Read the thermometer and record reading in the book.
11. Place the thermometer in the original alcohol container.
12. Repeat steps 8 through 11 for the second and third patients.
13. Remove the thermometers from the second alcohol container.
14. Repeat steps 2 through 12 for the next three patients.
15. Continue alternate use of the thermometer containers until all patients' temperatures have been taken.

[9] Tests at NNMC showed the important step in cleaning a thermometer was the mechanical action of rotary motion when wiping.

16. Record temperature, pulse, and respiration graphically on each patient's chart. Describe abnormal characteristics of pulse and respiration in observation column of the nursing notes.

Care of Equipment

After each use

1. Remove waste.
2. Reset tray.
3. Stow in proper place.

Daily

1. Filter alcohol.
2. Boil containers and tray for 10 minutes.
3. Wash thermometers in cool soapy water; rinse and dry.
4. Refill and reset tray.

NOTE.—Where sufficient thermometers are available for all patients, follow the procedure as outlined in "Thermometer technique in a communicable disease ward."

Procedure For Taking a Rectal Temperature

Equipment

Tray with:
- Rectal thermometer in disinfectant solution.
- Container soap solution.
- Container cool water.
- Container cotton squares.
- Sputum cup for waste.
- Lubricant on tissue.

Precautions

1. Wait for 30 minutes before taking the temperature after the patient has had an enema.
2. Use only a stub bulb thermometer expressly made for rectal use.
3. Be sure to lubricate the thermometer.
4. Hold the thermometer in place.

Procedure

Wash Your Hands!

1. With cotton square wipe down thermometer.
2. Shake down and lubricate thermometer.
3. Turn patient on his side.
4. Insert thermometer about 1½ inches into rectum in an upward and forward direction.
5. Hold thermometer in place 5 minutes.
6. Remove thermometer.
7. Moisten cotton with soap solution, wipe down thermometer; repeat, using water.
8. Read thermometer; place in disinfectant.
9. Take pulse and respiration.
10. Record TPR in book.
11. Record "R" above temperature in book and on chart.

For an Infant

1. Steps 1 and 2 above.
2. Unpin diaper.
3. Lift infant's legs with one hand, holding at the ankles.
4. Insert thermometer ½ to ¾ inches into rectum. Hold in place 5 minutes.
5. Proceed as in steps 6 through 11 above.
6. Repin diaper.

Figure 190.—Method of Holding Infant's Legs.

Procedure for Taking an Axillary Temperature

Equipment

Same as for an oral temperature plus hand towel.

Precautions

1. Be sure the axilla is dry.
2. Be sure the arm is pressed closely to the body.

Procedure

1. Wipe axilla dry.
2. Place the thermometer in axilla. Have patient grasp his opposite shoulder and press his arm against his body.
3. Leave in place 10 minutes.
4. Proceed as in oral temperature instructions.
5. Record "A" above temperature in book and on chart.

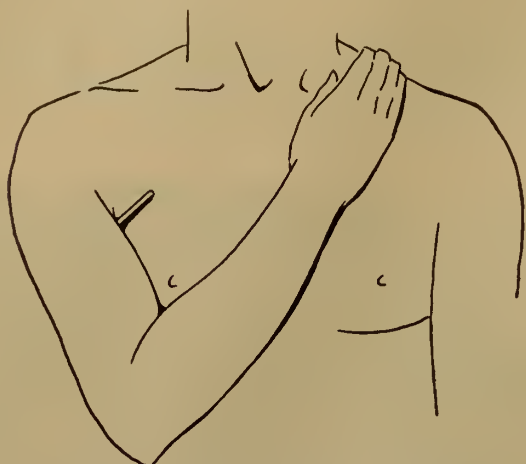

Figure 191.—Taking an Axillary Temperature.

BLOOD PRESSURE

Blood pressure is the force that the blood exerts against the walls of the vessels through which it flows. The blood pressure is commonly meant to be the pressure in the arteries. The pressure in the arteries varies with the contraction (work period) and the relaxation (rest period) of the heart. When the heart contracts the blood in the arteries is at its greatest pressure. This is called the systolic pressure. When the heart relaxes the blood in the arteries is at its lowest pressure. This is called the diastolic pressure. The difference between both pressures is called the pulse pressure.

Normal blood pressure.—A systolic pressure of 110 to 136 millimeters of mercury and a diastolic pressure of 60 to 90 mm. may be considered as being within the normal range. The pulse pressure is usually about one half the diastolic pressure.

Measurement.—The blood pressure is measured in the brachial artery by means of a sphygmomanometer and a stethoscope. The cuff of the manometer (containing a rubber bladder) is wound about the upper arm and is inflated with air until the air pressure inside the cuff equals the pressure of the blood inside the artery and the walls of the artery collapse. The air in the cuff is then slowly released until the first regular sound is heard; this is the **systolic pressure.** The air is further released until a change in the character of the sound is heard; this is the **diastolic pressure.**

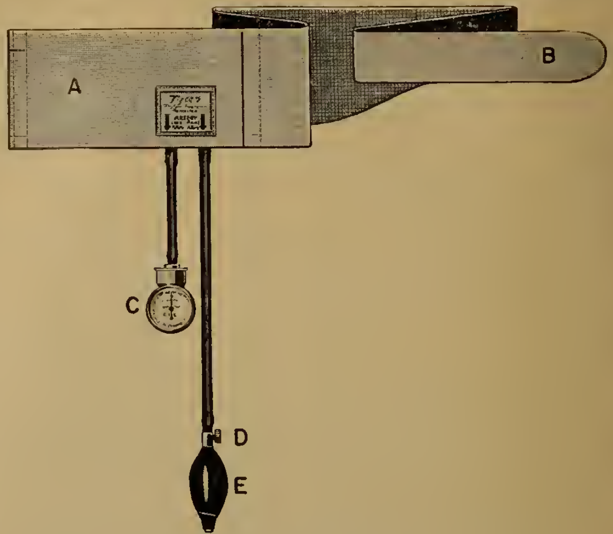

Figure 192.—Diagram of Blood-Pressure Apparatus.

Procedure for Taking a Blood Pressure Reading

Purposes

To determine the systolic and diastolic blood pressure in the brachial artery.

To determine the pulse pressure.

Equipment

Stethoscope.
Sphygmomanometer.
Alcohol sponges.

Precautions

1. Explain procedure to the patient to lessen his fears or apprehension.
2. Patient must be at rest, lying down in bed or sitting quietly in a chair with the arm to be used well supported.

3. Be sure the cuff of the apparatus is completely deflated and the indicator registers zero before starting the procedure.

4. Wipe the bell and earpieces of the stethoscope with an alcohol sponge before starting the procedure.

5. When repeated readings are ordered, the same arm should be used and the same person should carry out the procedure.

Procedure

1. Push patient's sleeve well above his elbow; if sleeve is tight, remove it.

2. Starting with the wide portion of the cuff (A) wrap it snugly and smoothly around the arm above the elbow. Tuck narrow end (B) under the previous turn (fig. 192).

3. Clip indicator (C) on the cuff (aneroid type) or place apparatus on a level surface (mercury type).

4. With the fingers, locate the brachial pulse at the bend of the elbow.

5. Place the stethoscope in the ears, earpieces facing forward.

6. Place the bell of the stethoscope over the spot where the brachial pulse was felt.

7. Tighten thumb screw of the valve (D).

8. Holding the stethoscope in place, inflate cuff with the bulb (E) until the indicator reads 200 mm. or to 20 mm. above where the sounds are no longer heard.

9. Loosen the thumb screw of the valve to allow the air to escape slowly.

Figure 193.—Taking a Blood Pressure Reading.

10. Listen for the sounds, watch the indicator and note the number on the indicator where the first distinct rhythmic sound is heard. This is the **systolic pressure.**

11. Continue releasing air from the cuff and note the number on the indicator at which the sound changes to a dull muffled beat. This is the **diastolic pressure.**

12. Open the valve completely, releasing all the air in the cuff.

13. Repeat steps 3 through 12 to recheck.

14. Remove the cuff from the arm; roll cuff from the narrow to wide portion and place it in its case. Be sure the tubing is not pinched or kinked.

15. Wipe earpieces and bell of stethoscope with an alcohol sponge.

16. Record in the nursing notes the systolic pressure over the diastolic pressure (Ex: B. P. 120/80) or graph as directed.

THE PATIENT'S CHART

Review—Appendix, Some Symptoms To Be Observed and Terms to Use in Recording Them

Purposes.—To provide a clear and concise record of the patient's condition and progress; to record effects and results of treatment the patient is receiving; to aid the doctor in making a diagnosis and in prescribing treatment; to help the corpsman adapt his nursing care to fit the needs of the patient; to provide records for study, research, and statistics.

Indicated.—For all patients.

Order of Patient's Chart

1. Temperature, pulse, respiration sheet—form 511.

2. Doctor's order sheet—form 508.

3. Doctor's progress sheet—form 509.

4. Nursing notes—form 510.

5. Laboratory reports—form 514 (reports 514 a–m are stapled to this sheet).

6. History, part I—form 504; parts II and III, form 505.

7. Physical examination—form 506.

8. All other forms required for patient.

9. When additional sheets are required, place them in front of the completed sheets.

10. Arrange charts in numerical order when sending to record office for change of diagnosis or upon patient's discharge.

The corpsman should be familiar with all clinical record forms but is responsible for maintaining accurate, complete, and up-to-date temperature, pulse and respiration sheets; nursing notes; intake and output records; plotting charts where used; and for stapling and/or inserting other forms and reports on the patient's chart.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z

One letter space between words

Figure 194.—Guide for Printing.

NURSING NOTES (FORM 510)

General instructions

1. All entries shall be printed in black ink. (Entire 24 hour period).

2. Navy date and time shall be used: (10 Jan 1952, 0200).

  a. Date shall appear only at midnight and at the beginning of each new page.

  b. Hour shall accompany each new entry.

3. Entries shall be signed in the observation column with the full signature of the person making them. The signature may be placed at the end of the day's entries if the same person has made all of them.

4. When an error is made, draw a straight line through error. Write "Error." If for any reason a page must be copied, it must be marked "Copy" and the original must be retained on the chart. No erasures are permitted.

5. Medication and treatment column.

  a. Diets and nourishments shall be included in this column.

  b. Liquid measures shall be in metric system.

  c. Name of medication, dosage, and manner of administration if other than by mouth, shall be recorded after it has been given.

  d. Name of treatment, amount of solution if used, and the duration of treatment if for prescribed time shall be recorded after it has been given.

  e. For diets, medications, and treatments that are repeated at stated intervals in a 24-hour period, chart the first time of the day they are given and the hours at which they are to be repeated. Draw a line through the first hour and place your initials above the hour. Draw a line through and initial the correct hour each time the diet, medication, or treatment is repeated. When a diet, medication, or treatment is not given for any reason, circle the hour, initial it, and record the reason for the omission in the observation column at the appropriate hour. When a medication or treatment is discontinued, make an X over the remaining hours listed.

  f. Treatments being given continuously shall be charted each morning and evening.

6. Observations column.

The recording of complaints and symptoms of the patient is an accepted responsibility of ward personnel. It is an account of the patient's condition and progress.

The record must be accurate, concise, clear, complete, and in language which is understood by all

Standard Form 510
Rev. Feb 1951
Promulgated
By Bureau of the Budget
Circular A—32

CLINICAL RECORD — NURSING NOTES (Sign all notes)

DATE	HOUR	MEDICATION—TREATMENT	OBSERVATIONS
15 Jan 1952	0900		ADM. TO WD. VIA WHEEL CHAIR. TO BED
			STAT. PLACED IN FOWLER'S POSITION
			FOR COMFORT STATES: "I CAN'T
			BREATHE WHEN FLAT IN BED."
			COMPLAINS OF SEVERE PAIN IN RT.
			ANT CHEST ON INSPIRATION. APPEARS
			WORRIED ABOUT CONDITION, ANXIOUS
			TO SEE DOCTOR. P. 92- FAIR VOLUME,
			REGULARLY IRREG. RHYTHM, EASILY
			COMPRESSED AT WRIST. R. 26- DYSPNEIC,
			SHORT, GRUNTING IN CHARACTER. HAS
			AN OCCASIONAL HARD, DRY COUGH.
			CYANOSIS NOTED ABOUT LIPS AND
			FINGERNAILS. Joseph Murphy HN
	0915	PHYSICAL EXAMINATION	- DR. DOOZIT
	0920	SULFADIAZENE GM. 2	- Joseph Murphy HN
	0930		CHAPLAIN VISITED. PT APPEARS MUCH
			CALMER, LESS ANXIOUS
	1030	ORANGE JUICE 240cc	VOIDED 300cc SPEC. TO LAB
	1100		DOZING. RESPIRATIONS APPEAR LESS
			DYSPNEIC; COLOR IMPROVED
	1130	SOFT DIET 11 - 4	APPETITE FAIR "I'M NOT USED to THIS
		WATER 90cc.	KIND OF FOOD." Brian Flanagan HM3

(Continue on reverse side)

PATIENT'S LAST NAME—FIRST NAME—MIDDLE NAME	REGISTER NO.	WARD NO.
O'DONNELL-JAMES JOHN - 627894 HM3	202020	110

USNH BETHESDA
(NAME OF HOSPITAL OR OTHER MEDICAL FACILITY)

16—68173-3

NURSING NOTES
Standard Form 510

Figure 195.—Sample Nursing Notes.

who have access to the chart. The terms used should be those of standard usage and should not be abbreviations or contractions unless on the accepted lists.

The lettering should be neat and uniform in height and in spacing. There should be a one letter space between words.

The report should be pleasing to the eye.

The report must be factual and truthful without interpretation. If interpretation of a patient's subjective symptoms is necessary, qualify statement by "appears" or "seems." Wherever possible, record patient's complaints in his exact words.

Each entry need not be a complete sentence but should contain sufficient words to convey a complete thought.

Each new thought will be started on a new line.

On admission of patient include—

1. Manner of admission.
2. Chief complaint of the patient.
3. Observation of the patient (objective and subjective symptoms).
4. Abnormal characteristics of the pulse and respiration must be fully described. Recording of TPR is not necessary; it is recorded on form 511.
5. Notification of doctor.
6. Nursing measures given.

Daily entries will include—

1. All observations made.
   Objective and subjective symptoms.
   Effects of medications and treatments.
   Changes in patient's condition.
2. All supportive nursing care given: hygienic, comfort, and diversional measures.
3. Use of restraints, siderails, and reasons why applied.
4. Notification of doctor.
5. Doctor's visits other than routine sick call.
6. Trips to other departments, clinics.
7. Working order of apparatus in use, such as Wangensteen, tidal drainage, etc.
8. Specimen sent to laboratory.
9. Any unusual happenings (fell out of bed, etc.).
10. Administration of last rites.

Temperature—Pulse-Respiration, Fahrenheit (Form 511)

General instructions

1. Use black ink for all entries.
2. After patient's name at the bottom of page, print his serial number, rank or rate, branch of service, or civilian status.
3. Form 511 is usable for one week. The graph is divided into seven major columns—one for each day. Each daily column is subdivided into two parts—a. m. and p. m. Each subdivision is further divided by two vertical dotted lines. Note that the dots in the lines divide the horizontal spaces into five even divisions.
4. For every four hour and twice-a-day readings place the recordings within the dotted lines.
5. For four-times-a-day readings, place the recordings on the dotted lines.
6. Use the same symbol, a dot the size of a pinhead, for indicating the temperature, pulse, or respiration.
7. The blank space beneath the graph and above the patient's name may be used as needed. Some uses of the space may be:

a. For twenty-four hour totals of intake and output.

b. Special medications or treatments.

Example of Form 511 in Use

Fill in spaces as shown on sample sheet. In space—

(1) Print hospital day.

(2) Print postoperative day.

(3) Print month and year.

(4) Print day and month.

(5) Print hours readings are made.

(6)-(7)-(8)-Record temperature, pulse, and respiration by dots corresponding vertically to hour, horizontally to scale. Connect dot with previous recording by a solid line.

(9) Full name, serial number, rank or rate, branch of service, or civilian status—Obtain this information from admission card.

(10) Hospital register number—Obtain this number from admission card.

(11) Name or number of ward.

(12) Name of hospital or medical facility.

NOTE.—Where repeated blood pressure recordings are required, the use of Form 512 is suggested.

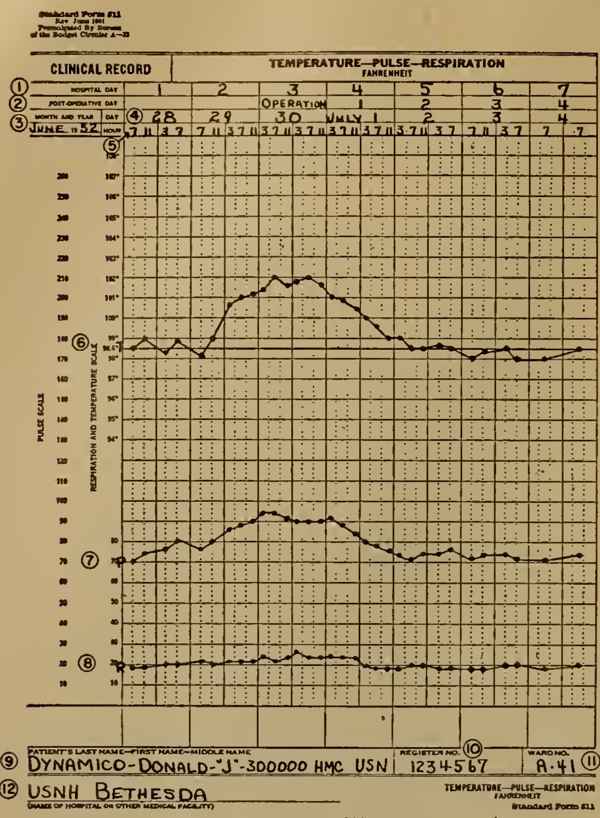

Figure 196.—Example of Form 511 in Use.

Plotting Chart (Form 512)

This form may be used for additional graphic representation of data.

Suggestions for Use:

Blood pressure recording.

Comparison of intake and output.

Weight chart.

Drainage chart.

General Rules for Constructing Graphs

1. Purpose of chart must be known; print purpose in upper left-hand space provided.

2. A graph should always read from left to right.

3. Measurement should be calibrated along vertical portion of graph.

a. Scale should be at a definite and uniform rate of progression. Ex.: 0—10—20—30, etc.

b. Scale should be labeled at top to show units of measure. Ex.: cc.—lbs.—mm.—gm., etc.

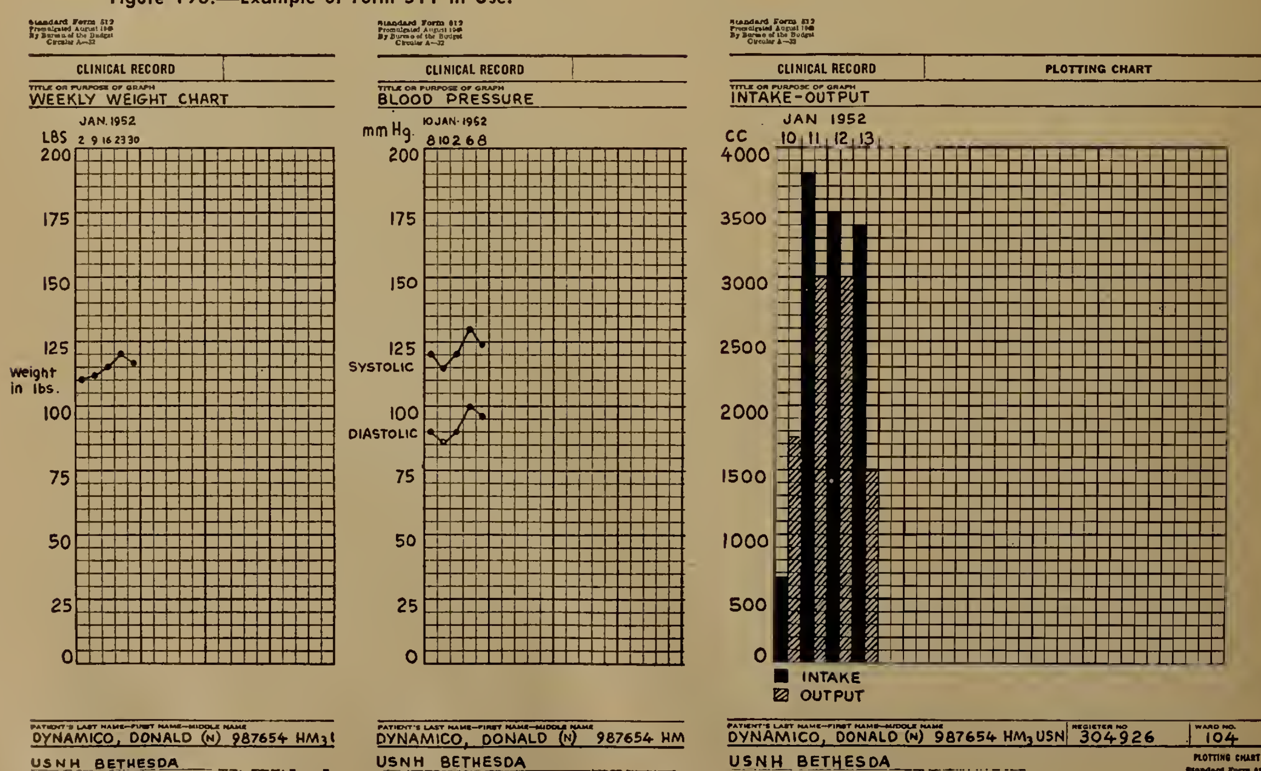

Figure 197.—Sample Plotting Charts.

4. Passage of time should be noted along horizontal portion of graph. Example: Dates and/or hours measurements are made.

5. Meaning of symbols used in graph should be shown in a key to the side of the graph.

6. When lines are used in graphing they should be labeled to the left of their starting points.

PROVIDING FOR THE PATIENT'S COMFORT

Review—Chapter II, "The Skeletal System"
"The Muscles"
"The Digestive System"
"The Excretory System"
Chapter V, "Food in Health and Disease"
Chapter VI, "Personal Hygiene for Individual Protection Against Disease"

Comfort [10] is the enjoyment of physical and mental well-being. This applies to the corpsman as well as to the patient.

One of the essentials of physical comfort is good posture. Good posture is the position of the body in correct alignment when standing, sitting, lying down, or in any phase of activity. The co-ordinated use of the body parts to produce motion and maintain equilibrium is termed "Body mechanics." The use of good posture and proper body mechanics by the corpsman when taking care of his patient will serve to:

1. Conserve the energy of the corpsman.
2. Promote the efficient use of muscles by the corpsman.
3. Avoid backstrain and fatigue of the corpsman.
4. Teach his patient, by example, the importance of good posture.

The maintenance of good postural position of the patient while in bed will serve to:

1. Promote the proper functioning of the body systems.
2. Promote a feeling of well-being.
3. Avoid fatigue and prevent deformities.

Providing for the mental comfort of the patient includes:

1. Adequate explanation of what is to be done.
2. Anticipating his wants.
3. Listening to his problems and referring him to the proper person or department when necessary.

These are but a few of the ways of providing for the mental comfort of the patient. The corpsman, by experience, will learn to recognize the general reactions of individuals, what causes people to behave the way they do and to use these experiences in providing more complete care for his subsequent patients.

[10] See p. 149, "Purposes of nursing."

Principles of Moving and Lifting

The following principles may be applied to any moving or lifting activity as well as to moving and lifting the patient.

1. Place your body in correct alignment before starting the activity.
2. Place your feet far enough apart to provide an adequate base of support and to maintain balance.
3. Hold the object to be carried as close to the body as possible so that the centers of gravity of both will be close together.
4. Use the large muscle groups to lessen strain and fatigue.
5. Stoop to working level, keeping the back straight.
6. Slide, rather than lift a patient or object whenever possible.
7. Give adequate support to the object or body to be moved. Obtain help when moving a heavy object or unmanageable patient.
8. Work in unison, give signal before starting activity.

Methods of Moving and Lifting

A. Prepare the patient and unit

1. Tell the patient exactly what is to be done and how he may help.
2. Bring all needed equipment to the unit.

3. Lock the wheels of the bed.

4. Fold all bedding and clothing so that the patient will not be hampered by them and yet will not be exposed.

B. Assume the correct position

1. Stand, facing in the direction of the move to be made, with the feet apart, one foot well in front of the other.

Figure 198.—Diagram. Body in Correct Position for Moving or Lifting.

2. Stoop to working level by flexing knees, keeping back straight.

3. Place arms under patient, keeping your elbows close to the body.

4. Set pelvis by tensing the abdominal and gluteal muscles simultaneously.

C. Move or lift patient by shifting own weight from one foot to the other

1. To move patient toward you, let arms holding the patient slide on the bed, shift your weight from front to rear foot.

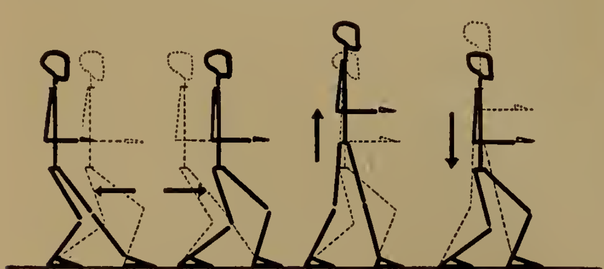

Figure 199.—Body in Motion When Moving or Lifting.

2. To move the patient away from you, let arms holding the patient slide on the bed, shift your weight from the rear to the front foot.

3. To lift the patient, keep elbows close to your body, straighten knees, equal weight on both feet.

4. To lower patient, keep elbows close to your body, flex knees to working level, equal weight on both feet.

To Move a Patient Up in Bed (One Corpsman)

Loosen drawsheet. Flex patient's knees, ask him to grasp rungs at head of bed. **Assume the correct position** behind head of bed. Grasp drawsheet under pillow at patient's head. Corpsman gives signal and moves patient by shifting own weight from front to rear foot. To pull up a mattress: Flex knees to working level—grasp underside of mattress and use the same method.

Figure 200.—To Move a Patient Up in Bed.

To Move a Patient Up in Bed When He Is Able To Assist

Assume the correct position at side of bed. Ask patient to flex his knees and to grasp rungs at head of bed. Place one arm under patient's shoulders and one under the buttocks. At corpsman's signal, patient pushes with his heels, straightens knees, flexes elbows. Corpsman assists by shifting own weight from rear to front foot.

Figure 201.—To Move a Patient Up in Bed When He is Able to Assist.

To Move a Helpless Patient Up in Bed With a Drawsheet (Two Corpsmen)

A corpsman stands at each side of bed. Loosen and roll drawsheet fairly close to patient. Flex patient's knees. Both corpsmen **assume the correct position.** At first corpsman's signal both move patient up in bed by shifting their weight from rear to front feet.

To pull up a mattress grasp underside of mattress, flex knees to working level and use the same method.

Figure 202.—To Move a Helpless Patient Up in Bed With a Drawsheet (Two Corpsmen).

To Help the Patient Sit Up in Bed

Assume the correct position at side of bed

Slip near arm under patient's near shoulder. Ask patient to place his arm into same position on

Figure 203.—To Help the Patient Sit Up in Bed.

your shoulder. Use other arm as support for patient's head. Give signal, raise patient by shifting own weight from front to rear foot. See "Back rest position" for supports.

To Move a Helpless Patient Up in Bed (Two Corpsmen)

A corpsman **assumes the correct position** on each side of bed. Flex patient's knees, ask him to

Figure 204.—To Move Helpless Patient Up in Bed (Two Corpsmen).

make himself rigid. Both corpsmen slide arms under patient's head and shoulders and under patient's buttocks—lock wrists. At one corpsman's signal both move patient by shifting their weight from rear to front feet.

To Turn a Patient on His Side

Assume the correct position at side of bed toward which patient is to be turned. Flex patient's knees. Place your hands on patient's far shoulder and hip. Slowly and gently turn patient toward you by shifting own weight from the front to the rear foot. Check patient's shoulder alignment. See "Side lying position" for correct supports.

Figure 205.—To Turn a Patient on His Side.

To Help the Patient Sit Up on Side of Bed

Dress patient in pajamas. Fanfold covers to foot of bed. Flex patient's knees, turn him on his side. **Assume the correct position.** Place one arm under patient's shoulder, the other behind the knees with hand under his lower thigh. Ask patient to place his hands around your neck or on your shoulders. Give signal, slowly bring patient to sitting position by straightening your knees as you shift weight from front to the rear foot. Support patient's feet on stool or chair.

Figure 206.—To Help the Patient Sit Up on Side of Bed.

To Help the Patient Out of Bed Into Chair

Place chair parallel to bed. Bring patient to a sitting position on side of bed. Dress him in bath-

Figure 207.—To Help the Patient Out of Bed into Chair.

robe and slippers. Allow patient to sit on side of bed until he is accustomed to this position. **Assume the correct position** in front of patient. Ask patient to place his hands on your shoulders. Place a hand on each side of the patient, midway between his axilla and hip. Supporting patient, allow him to slide off bed and stand on floor. Pivot with patient, lower him into chair by flexing your knees, shifting weight from rear to front foot, keeping your back straight.

To Help the Patient Into Wheel Chair

Place chair against bedside table or have another corpsman hold it. Fold back foot rests. Follow instructions "To help the patient out of

Figure 208.—To Help the Patient into a Wheel Chair.

bed to a chair." **Assume the correct position** of deep knee and hip flexion to adjust foot rests. For wheel chairs with adjustable knee rests, fold back knee rests until patient is seated, then adjust them.

To Move Patient From Bed to Stretcher

Place stretcher at right angles to the bed. Three corpsmen **assume the correct position** at the same side of bed. First corpsman places one arm under patient's shoulders, supporting the head on the crook of his arm, the other arm under patient's back. Second corpsman places his arms under patient's back and

Figure 209.—To Move the Patient from Bed to Stretcher.

thighs. Third corpsman places his arms under patient's thighs and calves. At first corpsman's signal, all slide patient to edge of bed. All corpsmen **again assume the correct position** and at first corpsman's signal, all lift by straightening knees; then turn and place patient on stretcher. To move the patient from stretcher to bed—use same method.

To Move an Injured Arm or Leg

Place pillows in readiness to support extremity. Place both hands beneath the injured limb, at joints above and below the site of injury. Raise limb slowly and gently. Place extremity on pillow, being sure the entire limb is supported. The toes or hands should be slightly higher than the rest of the extremity.

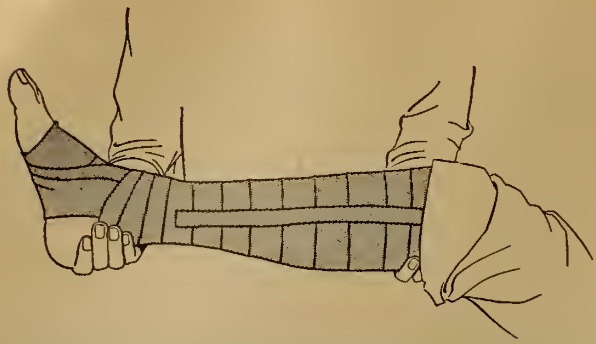

Figure 210.—To Move an Injured Arm or Leg.

Devices and Positions for the Comfort of the Patient

All devices used for the patient's comfort should:

Be large enough to support a part along its entire length.

Be firm enough to support, yet not cause pressure.

Promote correct anatomical alignment.

Conform to part of body being supported.

Figure 211.—Bed and Attachments.

The Gatch bed (fig. 211) allows the patient's position to be changed with the least exertion to him. Patients are all different sizes and heights. The breaks in the bed frames for the back and knee rests are in the same place on all beds. Therefore, in most instances, the knee rest will not be usable when the back rest is elevated and vice versa. The knees may be flexed by use of a pillow, rolled sheet, towel, or blanket. The feet should be supported so that they are at right angles to the bed (as in standing position).

Fracture board (fig. 211).—A board the width and length of the mattress used to prevent sagging of the mattress. Used particularly in the care of patients with back injuries or fractures.

Balkan frame (fig. 211).—An overhead apparatus attached to the bed providing a trapeze and attachments for traction. Used for patients who are in casts or who are paraplegics.

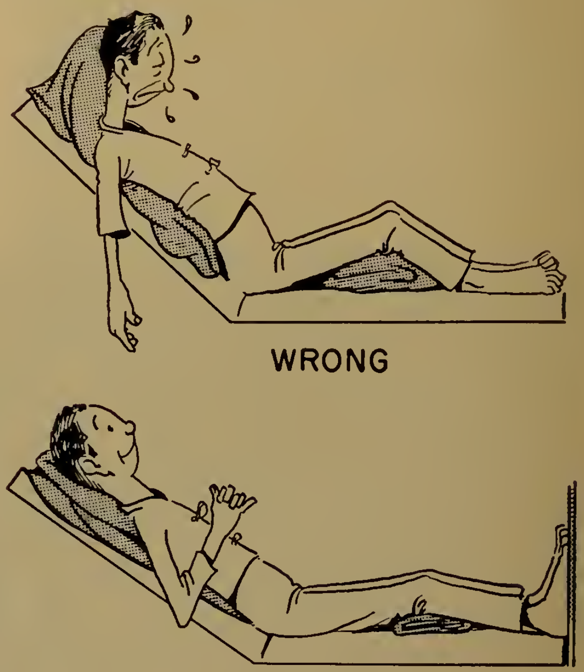

Figure 212.—Proper Use of the Gatch Bed.

Pillows.—Various sizes may be used, depending upon the purpose. Place pillows in rubber cases when there is a possibility of soiling them. Follow the rules for devices of comfort.

Footboard.—A board the width of the bed and at least three inches higher than the patient's toes

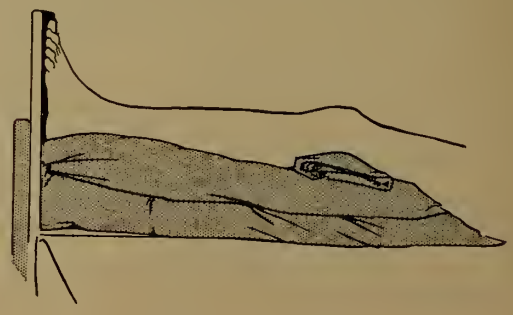

Figure 213.—Footboard.

may be used to support the feet. This board will help the patient stay in the correct position by preventing his slipping down in bed and will prevent the bedding from pressing on his toes.

Air ring.—An air ring may be used to relieve pressure on the coccyx, hips, or on any part of the body. The ring should be inflated just enough to raise the part off the bed. To inflate: Place a paper straw into valve of ring (or cover valve with gauze). Blow up until one-third full of air, close valve.

Figure 214.—Inflating Air Ring.

Place ring inside a cotton pillow cover. Place ring under patient so that the part to be protected is directly over the hole of the ring.

Precautions

1. Be sure valve of ring is away from patient's body. (Example: between legs when used to relieve pressure on coccyx.)

2. If ring is too hard after it is under the patient, open valve and release some air to fit the patient. A hard ring will cause more pressure than no ring at all. A soft ring does not relieve pressure.

Cotton rings (doughnuts).—May be used to relieve pressure on bony prominences (heels, ankles, elbows, shoulder blades). To make cotton rings take cotton wadding of sufficient size to support area. Form into a circle; wind 2- or 3-inch bandage around cotton to make an even, fairly firm ring. Finish bandage with a small piece of adhesive tape.

Note.—Where available, sponge rubber cut to fit the part to be supported, is recommended.

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Figure 215.—Making Doughnut.

Figure 216.—Placement of Doughnut.

Cradles are frames of various sizes used to keep weight of bedclothes off patient's legs, toes, or entire body. Anchor cradle to bed by tying to spring or rungs of bed with bandage or string.

Precaution.—Be sure patient has sufficient covers. He may need an extra blanket over upper part of bed.

Sandbags may be used to immobilize or support an extremity. Cover bag with a pillow case. (Special covers for sandbags may be requested to be made by the linen room.)

Precaution.—Be sure sandbag is long enough to support entire limb.

Positions of Comfort for the Patient

To provide good posture for the patient

1. Support natural spinal curves by use of back rests, pillows, air rings, etc.

2. Support feet at right angles to the legs by use of footboards, sandbags, etc.

3. Change patient's position frequently to prevent pressure on any one part of the body, to avoid strain on joints, and to prevent deformities.

4. Encourage patient to move about in bed, to provide exercise, to promote circulation, and to maintain good joint movement and good muscle tone.

5. Figure 217 illustrates the four principal positions of comfort for the patient.

Devices for the Safety of the Patient

The patient must be protected from injuring himself or others. The basic safety measure to protect all patients is to have all equipment in good working order. Some patients require additional protection, such as side bars, sheet or leather restraints.

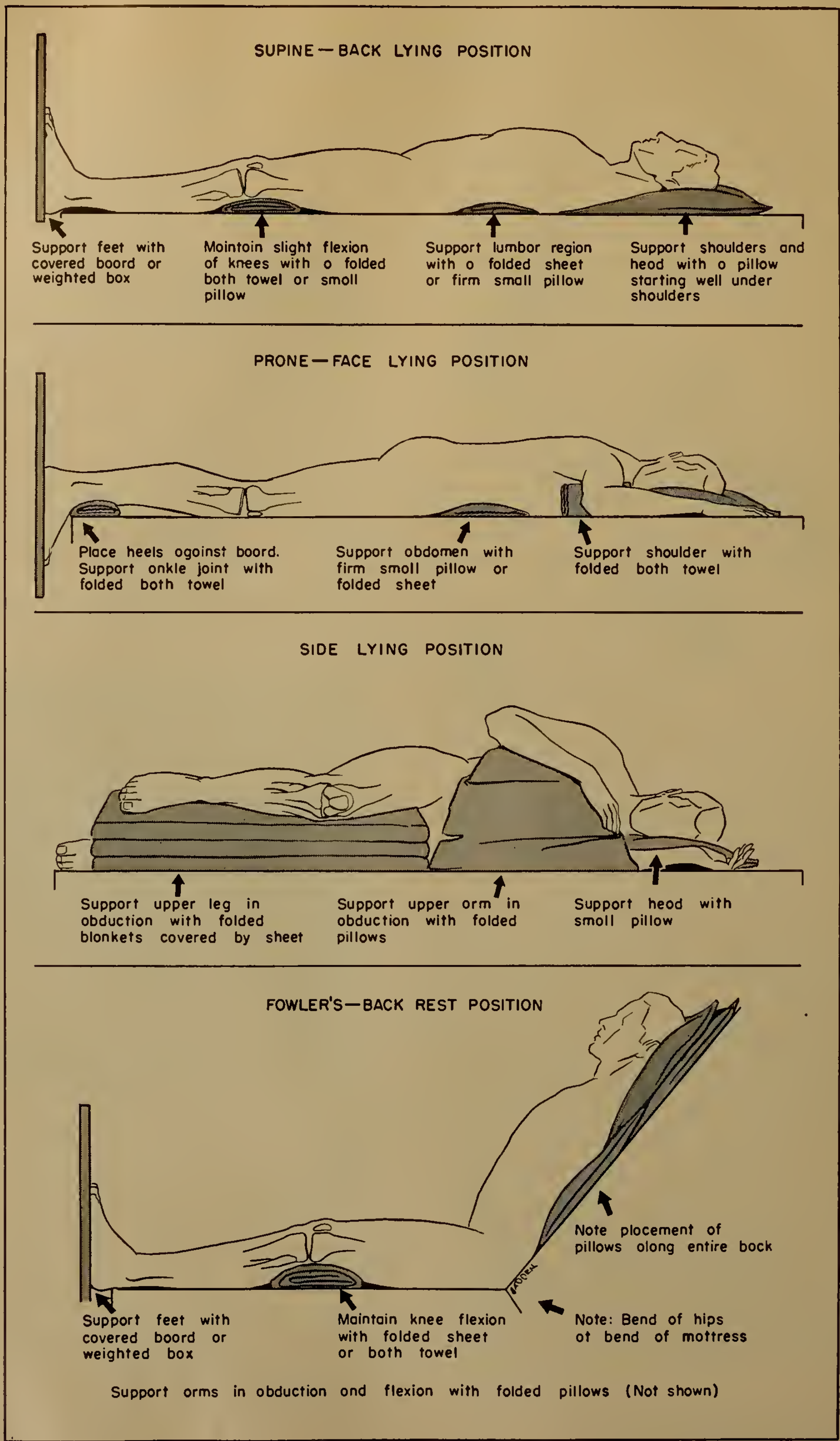

Figure 217.—Positions for Patient's Comfort. Turn page around. Note how anatomical alignment is maintained in all positions.

Side bars (fig. 211).—Side bars are metal bars, the length of the bed, that serve to keep the patient in bed. Some beds are equipped with bars that slide down when not in use much like a child's crib. There are detachable bars available for other beds. Side bars are used for patients who are confused, delirious, under sedation, or unconscious. They may also be used as a precautionary measure for patients who are blind or who have had eye surgery.

Sheet Restraints

1. Tucking in the top bedding along the sides of the bed may provide enough protection for the patient.

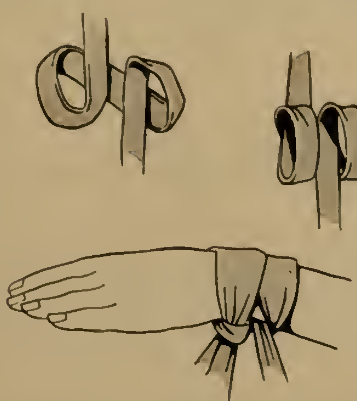

Figure 218.—Clove Hitch Sheet Restraint.

2. Folding a sheet in quarters and applying it across the patient's chest and tying it to the bars under the bed may be used. A doctor's order is required. Care must be taken that this restraint does not interfere with the patient's respiration.
3. Folding a sheet diagonally and applying it to the wrist or ankle by means of a clove hitch. A doctor's order is required. Care must be taken that patient's skin does not become chafed.

Leather Ankle and Wrist Restraints

These restraints MUST have a doctor's order; must be padded; must be loose enough to permit circulation of the parts of the body restrained; must be placed on opposite sides of the body (right wrist, left ankle); must be slack enough to allow some body movement.

Applying restraints

1. Pad the wrist or ankle with towel or cotton wadding.
2. Place cuff over pad.
3. Pass strap through loop of cuff and under bar of bed.
4. Allow enough slack in the strap to permit movement.
5. Lock strap.
6. Watch patient for signs of chafing, burning, or pressure sores.

Personal Cleanliness of the Patients

The need for personal cleanliness of a sick person is as great or greater than that for a well person. The care of the skin, mouth and hair follows the same general outline you do in your daily life. The amount of assistance the patient will need from you in attending to his personal cleanliness will depend upon the amount of activity permitted him by the doctor, his general and local condition. Most patients prefer to do as much for themselves as possible; others will need to be encouraged to assume their own care.

Oral Hygiene—Care of the Mouth

Purpose: To keep mouth clean, refresh patient; to prevent sordes, mouth odors; to stimulate appetite.

Indicated

Morning and evening for all patients.

Every 1 or 2 hours for patients who have mouth injuries or surgery; have sore inflamed mouths; are on "nothing by mouth."

Every 2 to 4 hours for patients who have fever; are unconscious, seriously ill, or dying.

Equipment

Glass of water.

Curved basin.

Tooth brush, dentifrice.

Hand towel.

Procedure

When patient is able to help himself

1. Place patient in comfortable position on backrest or on his side.
2. Arrange equipment within his reach on bedside table.
3. Remove equipment promptly when finished.

When patient needs some assistance

1. Turn patient on side.

Figure 219.—Assisting Patient with Oral Hygiene.

Figure 220.—Equipment for Special Mouth Care.

2. Place towel under his chin and over bedding (fig. 219).
3. Pour water over brush; place dentifrice on brush.
4. Give patient his brush; hold curved basin under his chin while he brushes teeth.
5. Give water to rinse mouth; take toothbrush.
6. Remove basin; wipe lips and chin with towel.
7. Make patient comfortable.
8. Remove equipment from unit.

Patient unable to help himself

1. Add drinking tube and tongue depressor to equipment.
2. Proceed as above, doing all steps for patient.

Brushing teeth:

Start at front teeth, brush from one side of mouth to the other.

Brush outer surfaces of the upper and lower teeth toward the biting edge.

Do inner surfaces of teeth in same manner.

3. Use drinking tube to rinse patient's mouth.

Special mouth care

Patients requiring special mouth care are the unconscious, dying patient, or one who has had surgery, injuries, or sores of the mouth.

Do not use force to clean wounds, to clean around wires, or to remove crusts.

Equipment:

Seven cotton applicators.
Mouth wash (1:3 solution)
Glass of water.
Tube.
Hand towel.
Curved basin.
Tongue depressor wrapped with gauze bandage.
Paper wipes.
Bag for waste
Mineral oil.
One ounce bulb syringe if patient is unable to use tube.

Procedure

1. Follow instructions as above. Moisten applicators in mouth wash. Use in the same manner as toothbrush.
2. Use new applicator for each section of mouth; discard into bag.

Figure 221.—Mouth Irrigation.

3. Use wrapped tongue depressor for cleansing tongue and holding mouth open.

4. Use drinking tube to rinse mouth. If patient is unable to use tube, turn his head to one side and gently irrigate mouth. Direct stream of solution to side of mouth.

5. Apply mineral oil to lips and gums.

6. Make patient comfortable, remove equipment.

Care of Equipment

1. Rinse toothbrush under cold running water; replace in patient's bedside table.
2. Discard waste in burnable trash can.
3. Wash metalware with soap and water, boil 20 minutes, dry and stow in proper place.
4. Wash glassware with soap and water, boil 10 minutes; dry and stow in proper place.

Charting

Nursing notes: Time, treatment, any unusual condition noted.

Signature.

Care of Dentures (False Teeth)

Indicated: Plates and bridges should be cared for as often and in the same manner as natural teeth.

Equipment

Glass or cup for teeth.
Toothbrush and dentifrice.

Procedure

1. Ask patient to place teeth in glass.
2. Take to utility room.

Figure 222.—Cleaning Dentures.

3. Place basin under tap in sink and place folded towel or washcloth in basin as a precautionary measure against breakage.
4. Wash dentures under warm running water over basin.
5. Use patient's brush and water, rinse dentures well.
6. Put teeth in glass; return them to patient.

Care of Equipment

Same as for oral hygiene.

Morning Care (A. M. Care) [11]

Purpose: To refresh and prepare patient for breakfast.

Indicated: For all bed patients, 1 hour before breakfast by night corpsman.

Equipment

Face basin one-half full of hot water.
Glass of water, curved basin.
Patient's toothbrush and dentifrice.
Hand towel, washcloth.
Soap in soap dish.
Comb.

Procedure

1. Offer bedpan or urinal.
2. Do oral hygiene.
3. Wash face and hands.
4. Prepare patient for breakfast:
   a. In correct position (Fowler's or on side).
   b. Clear top of bedside locker or overbed table for food tray.

Evening Care (P. M. Care)

Purpose: To relax and prepare patient for the night.

Indicated: For all bed and newly convalescent patients.

Equipment

Same as for a. m. care plus alcohol and powder.

Procedure

1. Follow instructions as for a. m. care.
2. Add back rub.
3. Straighten and tighten foundation bed, brush out crumbs, and freshen pillows.

---

[11] For Group of Patients: Use wheeled cart. Load with equipment as above. Add large pitcher of hot water, small pitcher of cold water. Distribute equipment to patients who are able to help themselves, then to patients who require help.

4. Bring bedside locker within patient's reach.
5. Give fresh drinking water.
6. Place extra blanket at foot of bed if night is cool.

Cleansing Baths

Purpose: To clean, relax, and refresh patient; to stimulate circulation, aid in elimination of body wastes; to observe patient.

Bed Bath

Indicated: Daily for all bed patients, preferably one hour before or after breakfast; newly admitted patients.

Figure 223.—Equipment for Bed Bath.

Equipment

Bath basin or foot tub one-half full of hot water (110° F.).
Soap in soap dish.
Rubbing alcohol, 50 percent.
Talcum powder.
Nail stick.
Nailbrush if needed.
Oral hygiene equipment.
Linen as needed.
Pajamas.
Bath towel.
Hand towel.
Washcloth.

Points to Remember

1. Use long, firm, smooth strokes in bathing.
2. Wash all parts of the body; soak hands and feet.
3. Use washcloth mitten fashion; avoid dangling ends.
4. Expose only that part being bathed.

Figure 224.—Mitten Wash Cloth.

5. Change water after bathing feet and when it becomes dirty, soapy, or cool.
6. Observe patient. Watch for signs of rash, scratching, pressure areas, vermin. Talk to patient during bath; find out how he feels. Any new pains? Aches? Worries? Happy?
7. Protect bedding with towel as each part is bathed.
8. Keep linen off deck. Place soiled linen in rungs of bed or in hamper.

Procedure—Preparation of patient and his unit

1. Screen patient, close windows, and check temperature of ward (72°–75° F.).
2. Tell patient what you are going to do.
3. Offer bedpan and urinal.
4. Gather equipment needed, except basin; bring to bedside.
5. Do oral hygiene.
6. Remove oral hygiene equipment; bring in basin of water.
7. Lower backrest; loosen top bedding at foot and sides of bed.
8. Remove pillow; strip and place on chair.
9. Fold spread from top to bottom; pick up in center and place on back of chair.
10. If ward is warm, blanket may be removed in same way.
11. Remove jewelry; place in drawer of bedside stand.

Order of bath

1. Eyes (no soap).
2. Face, neck, and ears.
3. Far arm, hand, nails.
4. Near arm, hand, nails.
5. Chest.
6. Abdomen.
7. Far leg, foot, nails.
8. Near leg, foot, nails.
9. Back, buttocks: Wash sides, back, buttocks; rinse and dry well.
   a. Pour alcohol into hands; then apply evenly to patient's back. Rub until back is dry.
   b. Sprinkle powder into hands; then apply to patient's back. Rub for 5 minutes. Use long, smooth, firm strokes; even pressure; establish definite rhythm; keep hands on back for duration of back rub.
10. Genitals—patient usually prefers to wash himself; corpsman will do so if patient is too ill.

Figure 225.—The Bed Bath. Patient's sheet is turned back to show method of draping.

After bath

1. Put on pajamas.
2. Comb hair.
3. Make up bed. (See "Occupied bed.")
4. Remove all equipment; leave unit clean and in order.
5. Leave patient comfortable:
   a. In correct position.
   b. Call bell, fresh water, and bedside table within reach.
6. Clean equipment. (See "Use and care of equipment.")

Male patient may shave himself either with his a. m. care or before his bath. When corpsman must shave patient, do so before bath or after lunch, before visiting hours.

Female patient: Give patient all her makeup equipment after the bed is finished. She will apply makeup while unit is being straightened.

When patient is able to bathe himself:

1. Bring equipment within his reach.
2. Assist him as necessary (back, legs, feet).
3. Make up bed; square-away unit.

Tub Bath

Equipment

Warm bathroom (72°–75° F.).
Stool or chair.
Bath mat.
Pajamas, bathrobe.
Bath towel, washcloth.
Soap in soap dish.

Procedure

1. Have bathroom warm without drafts.
2. Draw water for bath. Temperature of water should be comfortably warm.
3. Place bath mat on deck in front of tub.
4. Assist patient to undress; to get into tub; to wash and dry himself; to dress; to return to his bed.
5. Patient may carry out the entire procedure himself if he is able. Do not allow the door of the bathroom to be locked!

Precautions

1. Do not have the water too hot or too cold.
2. Do not have the bathroom so hot as to cause chilling when patient returns to ward.
3. Use proper body mechanics when stooping over to assist patient.

Charting

Nursing notes: Time, bath, observations made, signature.

Bedpan and Urinal Service

Placing and removing the bedpan

Purpose: To maintain proper elimination with least exertion to the patient.

Equipment: Bedpan, bedpan cover, and toilet paper.

Procedure

1. Screen unit. Take covered bedpan and toilet paper to bedside. (Bedpan may be warmed by running hot water over it and then drying it.)
2. Remove bedpan cover and tuck under mattress on side of the bed.
3. Lift bed covers; remove any air cushions and pillows.
4. Pull pajama coat above waist and pajama pants down to knees.
5. Flex patient's knees, slip one hand under the patient's back, raise his hips, and with the other hand, slip pan into place. (If patient is able to help himself, ask him to bend his knees, press heels against the bed, and raise his hips while you place the pan).[12]
6. Place toilet paper and bell cord within reach.
7. Leave patient alone unless he is too ill.
8. Answer light immediately and remove pan quickly.
9. For patient unable to cleanse himself: Ask patient to turn on his side off the pan; take toilet paper and clean patient.
10. Cover pan and place it on chair.
11. Fix bedding: leave patient in comfortable position.
12. Take pan to utility room; look at contents. Note amount, consistency, color, odor, and unusual appearance (mucus, worms):

    Normal stool—brown, formed, soft.

    Blood in stool—black, tarry.

    Absence of bile in stool—clay-colored gray.
13. Provide patient with basin of water, soap and towel to wash his hands.
14. Care of bedpan:

    Automatic washer: Place pan in sterilizer, close door, and push flusher valve. Push and hold steam valve for one minute. Remove pan and stow in rack.

    Manual washing: Add cold water to bedpan and empty contents into hopper; clean bedpan with brush and hot soapy water. Boil pan in utensil sterilizer for 20 minutes.

[12] Another method: Roll patient to side of the bed, place the pan against his buttocks, and then roll him back to the center of the bed on the pan. CAUTION: If the patient is heavy or unable to help, ask another corpsman to help you.

Urinal Service

Equipment: Urinal and cover.

Procedure

1. Bring covered urinal to patient.
2. Remove urinal promptly.
3. Clean urinal same as for bedpan.

Measured Intake and Output

Purpose: To compare the intake and output of fluids by the patient.

Procedure

1. Place a sheet of paper and pencil at patient's bedside.[13]
2. Rule sheet into columns for time, intake, and output.
3. When the patient drinks fluids, measure and record in time and intake columns.[14]
4. When patient voids, measure and record in time and output columns.
5. Total intake and output columns at 2400.
6. Start a new sheet at 0001.

Care of Incontinent Patient

Purpose: To keep the patient as clean and dry as possible; to prevent decubitus ulcers.

Incontinence may be due to:

1. Loss of muscle tone or paralysis of the anal and/or urethral sphincter.
2. Urinary retention with overflow.
3. Bedpan or urinal not given when needed.

Care

1. Answer patient's calls promptly.
2. Change bedding at once when wet or soiled.
3. Wash patient with soap and water ***each*** time he is wet or soiled.
4. Watch for signs of burning, redness, or breaks in the skin.
5. Give frequent back rubs alternating oil and alcohol.
6. Place patient on a bedpan at frequent intervals.
7. Place a urinal for a male patient. Be sure it is level and will not tip over. Empty, clean, and replace frequently.

[13] When patient is capable, show him how to keep his own record.

[14] Include as intake—fluids given by intravenous or hypodermocylsis. Include as output—fluids lost by vomiting, gastric or urinary drainage.

8. Use a large disposable pad or covered rubber sheet under the patient's buttocks.

9. Doctor may order an indwelling catheter to keep the patient dry. See "indwelling catheter" and "simple drainage."

Care of Bedsores (Decubitus Ulcer, Pressure Sore)

A bedsore is an ulcerated area due to poor circulation to a part as the result of pressure. The areas most likely to develop bedsores are the elbows, the heels, the coccyx, hips, buttocks, ankles, toes, shoulder blades, ears, and back of the head. All patients confined to bed are susceptible to bedsores. The patients most likely to develop bedsores are those with lowered vitality due to prolonged illness; the emaciated patients; paralyzed patients; unconscious patients; obese patients; the edematous patients; diabetic, cardiac, or nephritic patients; those with casts, splints, bandages, or in traction.

Figure 226.—A Bedsore.

Causes

1. Constant pressure on an area due to lying in one position too long.

2. Splints, casts, bandages, or traction improperly applied.

3. Moisture due to sweat, urine, feces, water, pus, or other discharges.

4. Friction due to too tight or wrinkled bedding.

5. Pimples or breaks in the skin.

6. Faulty use of the bedpan.

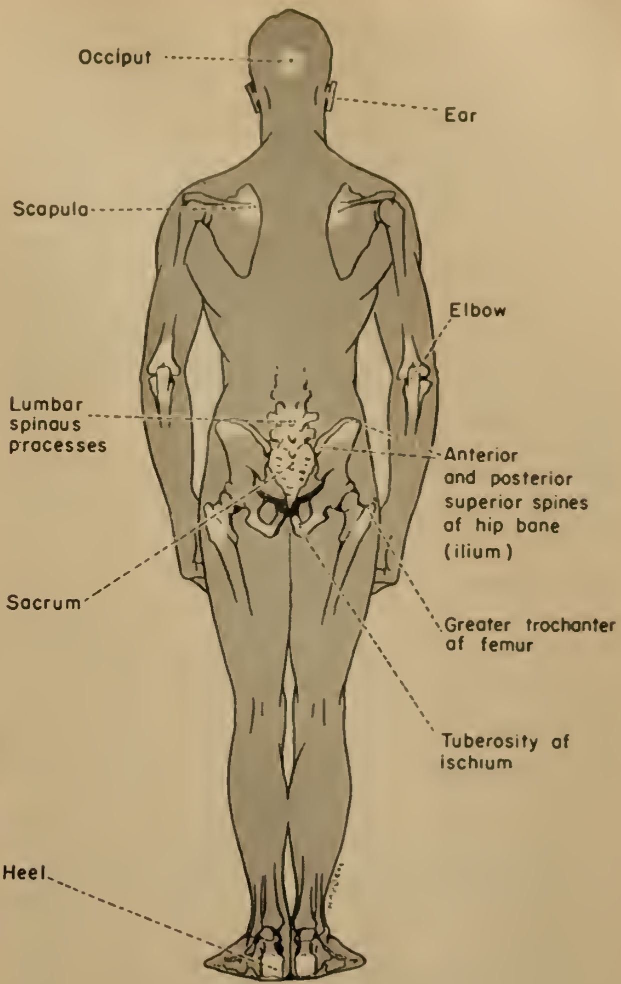

Figure 227.—Areas Susceptible to Bedsores.

Symptoms

1. Blanching of the skin which quickly turns red when the cause of the pressure is removed.

2. Patient complains of numbness, tingling, or tenderness.

3. Bluish or mottled discoloration of the skin.

4. Break down of the skin.

5. Ulceration.

Prevention

1. Inspect the skin of all bed patients every day during the bath and morning and evening care.

2. Change the patient's position every 2 hours.

3. Keep patient and his bed clean and dry.

4. Rub suspected areas frequently, alternate oil and alcohol rubs.

5. Wash, dry, and powder patient's skin each time he is incontinent.
6. Inspect all appliances frequently.

Treatment

1. Prevent bedsores by following instructions under prevention.
2. Report any suspicious areas immediately.
3. If skin is broken:
   a. Wash with soap and water; dry well.
   b. Rub the surrounding area with alcohol.
   c. Follow doctor's orders for other treatment or medication.

Serving Diets

The patient's appetite is stimulated by the time of day, by the sight, smell, and taste of food and by the manner and condition in which it is served to him. The ward should be quiet, odorless, and in readiness for meals. No treatments should be done, sick calls made, or visitors permitted during meal hours.

Standard diets

Liquid.

Clear—tea, coffee, broth, gelatines.

Full—added strained soups, juices, ice cream.

Soft—add chicken, beef; bland vegetables, puddings.

Light—add light salads, vegetables, lamb, veal, dessert, plain cake.

Regular—full house diet.

Special diets: For specific conditions. Certain foods are increased or decreased according to needs of the patient.

Preparation of the patient

Bed patient:

1. Clear bedside stand or overbed table.
2. Bring stand or table within patient's reach.
3. Place patient in sitting position or on his side.
4. Tuck a hand towel under his chin and across his chest.

Up patient:

Remind patient to be at his bedside when meals are served.

Where possible, serve up patients at a table in solarium.

Preparation of food trays

Wash your hands!

1. Inspect dishes, silverware, and trays for cleanliness.
2. Use clean serving utensils for serving food.
3. Follow diet list posted in ward diet kitchen.
4. Do not smoke while preparing, setting-up, or serving trays.

Setting-up food trays

1. Sugar, salt, pepper, and water go on most trays, but follow diet lists!

   Diabetic diets, omit sugar.
   Low salt, omit salt.
   Ulcer, omit salt and pepper.
   Restricted fluid, omit salt, pepper, water.
   Low fat, omit butter.

2. Place cold foods on tray—bread, butter, salad, dessert, milk. Wheel trays and food cart with serving utensils to center of the ward.

Serving trays

Be sure you have the right diet on the right tray for the right person!

1. Serve small portions; patient may ask for seconds.
2. Place foods in center of dishes; avoid spilling over sides.
3. Fill glasses, cups, and bowls to one-half inch from the top.

Figure 228.—Food Service.

4. Place hot foods on each tray as it is served.
5. Cut food into bite size and butter the bread for those patients unable to use knives.
6. Place tray in front of the patient so that the knife is on right side of the tray and all dishes are within his reach.

Order of serving trays

1. Serve bed patients who are able to feed themselves.
2. Serve up patients.
3. Hold trays for helpless patients until corpsmen are ready to feed them.

Collecting trays

1. Do not hurry your patients! Give them time to enjoy their food.
2. Collect trays on utility cart. Take to door of ward diet kitchen.
3. Remove trays one at a time.
   a. Scrape solids from dishes into garbage can; stack dishes.
   b. Pour liquids down sink; stack cups and glasses.
   c. Wipe and stack trays.
   d. Send trays, dishes, and silver to main galley.
4. Automatic dishwashers and sterilizers—follow instructions of manufacturer. Check temperature control. Follow step 5*b* if questionable.
5. Manual dishwashing and disinfection.
   a. Wash dishes, silverware, and trays with warm, soapy water.
   b. Immerse dishes and silverware in boiling water for 1 minute; allow to air dry.

Feeding the Helpless Patient

1. Place the patient in a sitting position unless otherwise ordered by the doctor.
2. Place a hand towel across the patient's chest; tuck a napkin under his chin.
3. Place tray on overbed table or on bedside stand.
4. Give the patient a piece of buttered bread if he is able to hold it.
5. Feed the patient in the order in which he likes to be fed.
6. Offer fluid during the meal. Use a drinking tube.
7. Do not rush your patient—give a small amount of food at one time; allow patient to

Figure 229.—Feeding a Helpless Patient.

chew and swallow food before offering the next spoonful.
8. If patient is inclined to talk, talk with him. It is an excellent time to observe your patient. Find out his likes and dislikes in food, particularly if his appetite is poor or if he is on a special diet.
9. When he is finished, lower backrest; fix his bed so that he may rest.
10. Take tray to diet kitchen; scrape and stack tray.
11. Note amount of food he has eaten; record amount of fluid if on measured intake and output.

Feeding the Blind Patient

1. Follow steps 1, 2, and 3 in feeding a helpless patient.
2. Tell patient what food is on the tray.
3. As you feed him:
   a. Tell him what you are offering him, whether hot or cold, and whether it is in a spoon, cup, or drinking tube.
   b. Allow him to hold a piece of buttered bread if he wishes.
   c. If doctor permits, start patient toward helping himself.
(1) Always set the tray in the same place in front of him.
(2) Always place the dishes in the same order on the tray.
(3) Always place the same type of food in the same clockwise position on dinner plate.

(4) Fill cups and glasses only half full to avoid his spilling fluids.

(5) Go slowly—help him by degrees; a little progress each day will help build his confidence. Stand by until he is sure and is confident of himself.

Feeding an Infant

Preparation of formula

1. Wash your hands.
2. Obtain the right formula for the right baby from the refrigerator.
3. Place the bottle in a pan of water sufficiently hot to heat the formula to about 100° F.

Preparation of the infant

1. Don nursery gown, change baby's diaper, and wrap baby in baby blanket.
2. Wash your hands.

Feeding the infant

1. Pick up the baby, cradling and supporting his head and back on your arm. Sit down in a straight-backed chair.
2. Pick up the bottle of formula; sprinkle a few drops on the inner surface of your wrist to test the temperature of the formula (should be slightly warmer than body temperature).
3. Place nipple in the baby's mouth. Be sure the neck of the bottle is always filled with formula.
4. Note the rate of flow of the formula.

A flow too rapid may cause the baby to choke or to lose the formula and may be due to the nipple being too soft and old or nipple holes being too large. Replace nipple.

A flow too slow may cause the baby to work too hard to get the formula and may be due to the nipple holes being too small or clogged (replace nipple) or to the presence of an air lock. (Stop feeding: hold bottle upright for a second and then continue feeding, being sure the neck of the bottle is always filled with formula.)

Figure 230.—Feeding an Infant.

PREVENTING THE SPREAD OF INFECTION

Review—Chapter VI, "The Nature of Communicable Diseases"

"The Body's Defenses Against Disease"

Chapter VII, "The Antiseptics"

The measures used to prevent the spread of infection among all patients have already been mentioned. They are repeated here to stress their importance.

1. Keep space between beds at 8 foot center intervals.
2. Have for each patient a complete bedside unit: bed, bedside locker, and chair.
3. Keep patient's belongings within his unit.
4. Consider deck, inside of sinks and hoppers as contaminated.
5. Bring only clean articles and utensils to the patient; disinfect or sterilize them after he uses them.
6. Sterilize dishes after each meal.

7. Consider all body discharges and excreta as possible disease carriers and treat them as such.

8. Wash hands after the care of each patient and after each task. Use plenty of soap (to emulsify the dirt), friction (to loosen the dirt), and running water (to get rid of the dirt).

When a patient is known to have a communicable disease or has a wound, additional measures are used to prevent the spread of infection.

Medical aseptic technique is used in caring for a patient with a communicable disease. The purpose of this technique is to confine the disease to the patient and to protect the worker and other patients from the infection. The technique consists of isolating the patient in a separate ward, room or unit: the concurrent disinfection of materials and utensils coming from patient, and the use of protective clothing by the worker while caring for the patient.

Surgical aseptic technique is used in caring for a patient with a wound. The purpose of this technique is to protect the patient from infection that is possibly carried in the air, by the worker, by worker's equipment, or by other patients. This technique consists of segregating the patient in a separate ward, room or unit: sterilization of all articles going to the patient's wound and sometimes the wearing of sterilized clothing by the worker.

Modifications of both techniques are used in various ways in many departments of the hospital.

In pediatric and nursery wards.—Masks and gowns are used to protect the infant or child from possible infection by the worker.

In surgical wards.—All articles coming in direct contact with the wound are sterile. Masks and gowns may also be worn when caring for a patient with extensive burns or wounds.

In all wards.—Articles used for injections, irrigations, and instillations are sterile.

These techniques serve a dual purpose. They protect both the worker and the patient. There are definite methods of handling contaminated and sterile articles to protect the worker and the patient. These methods must be followed faithfully to give the protection they were designed to give. Much depends upon the individual honesty of the worker and upon his learning to recognize when a thing is **clean**—free from pathogenic organisms: **sterile**—free from all organisms; **contaminated**—has been in contact with pathogenic organisms; and **unsterile**—has been in contact with organisms (not necessarily pathogenic) and is not usable in sterile field.

The most important single factor in preventing the spread of infection is adequate handwashing.

Table I.—COMPARISON OF MEDICAL AND SURGICAL ASEPTIC TECHNIQUES

Medical aseptic technique	Surgical aseptic technique
Indicated in presence of communicable disease.	**Indicated** in presence of open wound.
Emphasis on cleanliness (freedom from pathogenic organisms).	**Emphasis** on sterility (freedom from all organisms).
Preventing the spread of infection	**Preventing the spread of infection**
Purpose: To confine disease or infection to the patient. To protect other patients and workers from additional disease. To maintain cleanliness. To protect patient from other infections which may cause serious complications in his disease.	**Purpose:** To protect patient having open wound from possible disease of worker or other patients. To maintain sterility.
Isolation	**Isolation**
Patient with communicable disease is separated from rest of hospital by room, ward, or area.	Patient is operated upon in surgery—a separate department away from rest of hospital. Patient with wound is assigned to a surgical ward.

Table I.—COMPARISON OF MEDICAL AND SURGICAL ASEPTIC TECHNIQUES—Continued

Medical aseptic technique	Surgical aseptic technique
Zone about unit is established as contaminated. Once an article touches a contaminated surface, it is contaminated. Nothing goes out of zone without being sterilized, disinfected, or wrapped in a clean cover.	Zone about site of operation or wound is established as a sterile field. Once a sterile article touches an unsterile article, it is unsterile. Only sterile articles are brought into the sterile field.
Handwashing	**Handwashing**
Worker's hands and forearms are washed to protect other patients, workers, and self, from disease of patient. Plenty of soap, water, and friction are used, rubbing well between fingers and around nails. Hands are held down over basin to allow water to drain off fingertips. Hands and arms are dried with paper towels. Lotion suggested to keep skin in good condition.	Worker's hands and forearms are scrubbed to prevent infecting patient. Plenty of soap, water, and friction are used, rubbing well between fingers and around nails. Brush may be used. Hands are held up under tap to allow water to drain off elbows. Hands and arms are dried with a sterile towel.
Gowns	**Gowns**
Clean gowns are worn. Gowns are worn to protect the worker from patient's disease. Inside of gown is kept clean; outside of gown is in contact with patient and his articles and therefore is contaminated. Gown is worn in the care of one patient or group of patients with same disease.	In surgery, sterile gowns are worn. Gowns are worn to protect the patient from infection possibly carried by the worker. Outside of gown is in contact with sterile field—therefore must be kept sterile. Gown is worn for one operation only.
Caps	**Caps**
Caps are worn to protect workers from disease-laden droplets or air-borne organisms.	Caps are used to protect patients from possible infection carried by workers.
Masks	**Masks**
Masks are worn to protect worker from inhaling disease organisms of patient. Masks also protect patient from worker (i. e., worker has cold).	Masks are worn to protect an open wound and patient from disease organisms exhaled by worker. Masks also protect worker from inhaling disease organisms of a patient.
Gloves	**Gloves**
Gloves are initially sterile. Gloves are worn to protect worker when handling articles carrying infectious material.	Gloves are sterile and worn to protect wound from organisms since hands cannot be sterilized. Gloves are in contact with sterile field; therefore must be sterile.

Table I.—COMPARISON OF MEDICAL AND SURGICAL ASEPTIC TECHNIQUES—Continued

Medical aseptic technique	Surgical Aseptic technique
Linen	**Linen**
Requires special handling to protect ward and laundry workers. Placed inside clean bag or container, tagged "contaminated" and taken to laundry at special times. Where proper laundering facilities are available, organisms are killed in laundering process. Where facilities are questionable, linen is autoclaved for 30 minutes before being sent to laundry or is soaked in disinfectant solution for 2 hours.	Surgery: Has own supply. After laundering it is packed and sterilized by autoclave. Kept sterile until and during operation. On Ward: Linen used about wounds is packed in metal containers or wrapped in double muslin covers and sterilized by autoclave. Linen is kept sterile until used.

For detailed discussion of techniques see "Medical aseptic technique," pages 262–268, and "Surgical aseptic technique," pages 251–256; 295–300.

SUGGESTED ADDITIONAL READING—UNIT II

AMERICAN RED CROSS, *Home Nursing*, Philadelphia: Blakiston Co., 1950.

DAKIN, FLORENCE and THOMPSON, E. M., *Simplified Nursing*, 4th ed. Philadelphia: J. B. Lippincott Co., 1951. Part VI, sec. 29–31.

FASH, BERNICE, *Body Mechanics in Nursing Arts*. New York: McGraw-Hill Book Co., 1946.

MCCULLOCH, ERNEST C., *Disinfection and Sterilization*, 3d ed. Philadelphia: Lea and Febiger, 1948.

MONTAG, MILDRED and FILSON, MARGARET, *Nursing Arts*. Philadelphia: W. B. Saunders Co., 1948. Parts II, III. Part V, Chap. 17–19.

SMITH, C. RICHARD, "Alcohol As a Disinfectant Against Tubercle Bacilli," *Public Health Reports* 62: 36 (September 5, 1947), pp. 1285–1295. Abstract: Bureau Medicine and Surgery Newsletter 10: 8 (February 1948).

STEVENSON, JESSIE L., *Posture and Nursing*, 2d ed. New York: Joint Orthopedic Nursing Advisory Service of National Organization for Public Health Nursing and the National League of Nursing Education, 1948.

YOUNG, HELEN and LEE, ELEANOR and ASSOCIATES. *Essentials of Nursing*. 2d ed. rev. New York: G. P. Putnam's Sons, 1948. Part II, sec. 4–12.

Read the current issues of periodicals for the latest information on the care and comfort of your patient.

Periodicals available at most stations are: Armed Forces Medical Technicians Bulletin and American Journal of Nursing.

ASSISTING WITH AND PERFORMING DIAGNOSTIC AND THERAPEUTIC PROCEDURES—UNIT III

Diagnostic and therapeutic procedures have so greatly increased in number, scope, and complexity, that the corpsman may find himself spending the greater portion of his time on duty assisting with or performing these procedures.

In order to intelligently assist with or perform these procedures the corpsman should know:

1. How and why the procedure is done.
2. What care the patient should have before, during, and after the procedure.
3. What role he takes in the procedure; what part the doctor or technician assumes.
4. What equipment is necessary for the procedure; whether the equipment should be clean or sterile.
5. The time of the day the procedure may be performed to obtain the best results.
6. What symptoms and reactions are expected as a result of the procedure. What symptoms or signs of untoward reactions may occur.

When assisting with or performing these procedures, always strive to keep in mind that each one has been ordered by the doctor for a patient. The benefit the patient will derive from the procedure will depend to a considerable degree upon your ability to explain the procedure sufficiently to him so that he understands what is to be done, why the procedure has been ordered, and how he may help to assure the success of the procedure.

Diagnostic tests and examinations are presented in table form for quick and ready reference. All tests listed should be checked with local station orders since methods vary in different localities. The tables are preceded by general instructions for the preparation of the patient, collection of specimens, and for charting notes.

Therapeutic procedures are discussed in subsequent sections.

DIAGNOSTIC TESTS AND EXAMINATIONS

Review—Local Station Orders

Chapter II, Section Pertaining to the Anatomy or Physiology of the Part of the Body To Be Examined

Chapter X, Section Pertaining to the Desired Test or Examination

GENERAL INSTRUCTIONS

Preparation of the patient

Explain the test or examination to the patient.

Show the patient how to cooperate to make a successful test or examination.

Provide transportation (wheel chair. stretcher) when test or examination is performed in another ward or department.

Care of the patient after test

Relieve pain if present.

Heat and serve food if meal has been withheld.

Give bath or a. m. care if either have been omitted.

Charting

Nursing notes:

1. Specimens:
   - Time of collection.
   - Type of specimen.
   - Name of test ordered.
   - Amount of specimen in cc. if measurable.
   - Any other item affecting the result of the test.
   - Example: 1000: Bromosulfalein 25 mg. I. V. given by Dr. Jones. 1030: blood specimen taken.
2. Special tests or examinations:
   - Time of the test.
   - Name of the test.

By whom the test was performed.

Name of the doctor doing the test if done on the ward.

Amount and description of fluid obtained if applicable.

Special preparation of the patient for the test.

Reaction of the patient to the test.

Example: 1000: lumbar puncture by Dr. Jones. 5 cc. clear colorless spinal fluid obtained. Manometer pressure 150 mm. Patient placed in prone position. Patient cautioned to remain flat in bed. 1030: complains of headache.

Collection of Specimens

Observe the nine rights for collecting specimens. Be sure that—

1. The right specimen, from
2. The right patient, collected in
3. The right manner, at
4. The right time, into
5. The right container, in
6. The right amount, and with
7. The right label, is taken to
8. The right place in the laboratory, and handed to
9. The right person.

Precautions to observe when collecting specimens:

1. Wash your hands before and after touching specimens and containers.
2. Keep the outside of the container clean to protect other personnel handling specimen.
3. Attach request for examination to the specimen container with a rubber band, string or clip. Exception: Keep request separate when specimen is from a patient with a communicable disease. Place specimen container inside a clean paper bag and clip request to clean side of bag.
4. Do not send specimens to the laboratory that have been spoiled by cigarette butts, matches, tissues or other debris.

Table II.—COLLECTION OF SPECIMENS[1]

CHECK LOCAL STATION ORDERS

Specimen or test	Equipment	Method of collection	Duty of ward corpsman	Normal values
SECRETION OR EXCRETION				
A. *Urine:* 1. Single: a. Clean.	Urinal or bedpan. Specimen bottle witb cap. Rubber band. Request Form 514a.	Patient voids into clean urinal or bedpan. Sample 120–150 cc. is poured into specimen bottle, capped. Request is wrapped around bottle, held in place by rubber band.	Make out request, collect specimen, send specimen to laboratory. Receive and staple report to Form 514.	Reaction—acid. Specific gravity: 1.012 to 1.024. Albumin: negative. Sugar: Negative. Acetone: Negative. Microscopic: Blood: Negative. Pus: Negative. Bacteria: Negative. Epithelial cells: Few.
b. Sterile.	Catheterization tray. Sterile specimen bottle. Sterile 4 x 4 (2). Rubber bands (2). Request Form 514a.	Patient is catbeterized per doctor's order. Urine is collected directly from catbeter into bottle, sterile 4 x 4s are placed over top of bottle; held in place by rubber band.	Same as 1.	Same as 1.
2. 24-hour (quantitative).	Urinal or bedpan. Gallon bottle (from laboratory). Shipping tag. Request Form 514a.	Sbipping tag is made out with patient's name, rate, date, type of specimen; tied to gallon bottle. All urine voided is placed in gallon bottle.	Instruct patient. Collect specimen for 24 hours (0700–0700) continue as in 1. Send entire specimen to laboratory.	Quantity: 1,000 to 1,800 cc. in 24 bours. Specific gravity: 1.012 to 1.024. Sugar: Negative. Albumin: Negative. Bacteria: Negative.
3. Guaiac test for blood. 4. Addis count for cell count.	Normal value: Negative. Normal value: RBC: Negative. WBC: Negative. Casts: Negative. Epithelial cells: Few.	Botb tests require same equipment, metbod of collection as in 1 above. Specify tbe name of the test and tbe time of collection on Form 514a.		

[1] Sources:
Naval Medical School. *Instructions for Requesting Laboratory Services*, Bethesda (NNMC) 1949.
Gulli Muller and Dorothy E. Dawes. *Introduction to Medical Sciences* (2d Ed.) Pbiladelpbia: W. B. Saunders Co. 1948.
Esther McClain, *Scientific Principles in Nursing* (St. Louis: C. V. Mosby Co.) 1950.

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Table II.—COLLECTION OF SPECIMENS—Continued

CHECK LOCAL STATION ORDERS

Specimen or test	Equipment	Method of collection	Duty of ward corpsman	Normal values
SECRETION OR EXCRETION—Continued A. *Urine*—Continued 5. Benedict's test for sugar (usually done on ward).	Bedpan or urinal. Benedict's solution. Alcohol lamp. Medicine dropper. Test tube and holder. Matches.	Collect in same manner as for single specimen 20 to 30 minutes before meals or as ordered by doctor. Place 5 cc. Benedict's solution in test tube. Add 8 drops of urine to solution. Light alcohol lamp. Boil solution for 1 minute. Note reaction— Blue, clear, no change in color: Negative. Cloudy, slight change in color, green: 1 plus. Cloudy, yellow green: 2 plus. Cloudy, yellow brown-red: 3 plus. Cloudy, orange, brick red: 4 plus.	May do the entire test or send specimen to laboratory with request as in 1. Check "sugar" on Form 514a.	Negative.
6. Clinitest. Reagent test for sugar (usually done on ward).	Clinitest reagent tablets No. 2102. Bedpan or urinal. Test tube. Medicine Dropper. Clinitest color chart.	Collect as for single specimen 20–30 minutes before meals or as ordered by doctor. Place 5 drops of urine in test tube. Rinse dropper then add water to the test tube. Drop 1 clinitest tablet into tube, watch solution boil. Wait 15 seconds after boiling stops, then shake tube gently. Hold tube next to color chart and compare. All shades of blue: Negative. More than 2 percent causes rapid change to green, olive tan, orange, brown: Positive.	May do the entire test. Report and record result.	Negative.
Acetest reagent test for Acetone.	Bedpan or urinal. Medicine dropper. Acetest reagent tablets. Paper towels.	Collect as for single specimen. Place paper towel on table. Place tablet on towel. Place 1 drop of urine on tablet, wait 30 seconds, watch color. After 30 seconds, no change in color or cream shade due to wetting. Negative. Lavender to deep purple: Positive.	May do entire test. Report and record result.	Negative.
B. *Feces:* 1. Ova and Parasites.	Clean bedpan. Sputum cup with cover. 2 tongue blades. Request Form 514g. Rubber band.	Time: Early a. m. before 0800. Collect specimen [4] in clean bedpan. Take bedpan to utility room. With tongue blade, remove feces from pan; place in cup: fold request, name uppermost, and place on top of cover. Hold request in place with rubber band.	Collect specimen. Send specimen to laboratory. Receive report: Staple to Form 514.	Negative.
2. Occult blood.	Same as B1, add: Meat-free diet.	Same as B1. Patient is placed on meat-free diet several days before specimen is collected.	Same as B1.	Negative.
3. Amoeba.	Clean bedpan. 2 tongue blades. Glass specimen jars (obtain from laboratory). Basin warm water. Request Form 514g.	Time: Early a. m. if possible. With tongue blades, remove feces from pan; place in specimen jar. Place jar in basin of warm water.	Same as B1. Take to laboratory immediately, call to technician's attention.	Negative.
C. *Sputum:* 1. Single.	Sputum cup with cover. Request Form 514–E. Rubber band.	Time: Early a. m. before breakfast. Patient rinses mouth; coughs deeply, expectorates directly into cup. Cover cup, fold request, on top of cup, hold in place with rubber band.	Instruct patient, collect and send specimen with request to laboratory. Receive report, staple to Form 514.	Usually taken when tuberculosis is suspected. Negative for AFB.
2. 24 hour.	Wide mouth jar with cover (obtain from laboratory). Form 514–E. Rubber band.	Start and stop at definite time (Ex: 0600–0600). All sputum is expectorated by the patient directly into jar. Keep jar covered.	Same as C 1.	Same as C 1.

[4] Specimen should be at least size of walnut. When specimen is of fluid consistency, glass specimen jar is recommended.

Table II.—COLLECTION OF SPECIMENS—Continued

CHECK LOCAL STATION ORDERS

Specimen or test	Equipment	Method of collection	Duty of ward corpsman	Normal values
SECRETION OR EXCRETION—Continued				
D. *Gastric contents:* 1. Gastric wash (fasting specimen).	Levin tube in basin of cracked ice or cold water. Lubricant (may be water, saline, mineral oil, or lubricating jelly). Rubber sheet and cover. Curved basin. Sterile: 20 cc. syringe, specimen tube, normal saline solution. Request form 514–E.	Time: Early a. m. before breakfast. Levin tube is passed into stomach. Syringe is attached to tube. Specimen is withdrawn and placed in specimen tube. If fluid cannot be aspirated: 15 cc. saline solution is injected through tube, specimen withdrawn and placed in specimen tube.	Explain to patient. Place patient in sitting position. Place covered rubber sheet over chest. Assist doctor. Send specimen with request to laboratory immediately. Receive report, staple to Form 514. NOTE: If specimen is to be collected by ward corpsman: See: Gastric intubation. Follow instructions in "Method of Collection" column. Where gastric washes are repeated frequently patient may be taught to pass tube. (On doctor's orders.)	Usually taken when tuberculosis is suspected. Normal: Negative for AFB.
2. Gastric analysis, single fasting specimen.	Levin tube in basin of cracked ice or cold water. Lubricant (may be water, saline solution, mineral oil, or lubricating jelly. Clean test tube. Rubber sheet and cover. Curved basin. Request form 514–F.	Same as D 1. Omit introduction of saline.	Same as G 1.	Fasting specimen. Total acidity: 15° to 45°. Free hydrochloric acid 5° to 30°.
3. Fractional gastric analysis. a. Alcohol test meal.	Same as D 2. Add 6 test tubes in rack from laboratory. 50 cc. syringe. Label tubes "fasting," Nos. 1, 2, 3, 4, 5, 50 cc. alcohol 7 percent	Fasting specimen collected as in D 1. 50 cc. 7 percent alcohol is introduced through tube. Samples of gastric contents are withdrawn at stated intervals.	Same as D 1 for fasting specimen. Inject 50 cc. 7 percent alcohol through tube. Collect 15 cc. samples. First, 15 minutes after alcohol. Second, 30 minutes after alcohol. Third, 1 hour after alcohol. Fourth, 1½ hours after alcohol. Fifth, 2 hours after alcohol. Be sure each specimen is labeled correctly. Take rack of specimens and request to laboratory. Receive report, staple to form 514.	Fasting specimen as above. 1 hour after alcohol. Free H Cl 20°. Total acidity 30° to 80°.
b. Histamine: This test does not always follow the alcohol test meal. The doctor writes a specific order for histamine to be used.	Same as above. Histamine as ordered. Hypo syringe and needle. On hand: Syringe containing adrenalin 0.5 cc.	Histamine is given subcutaneously 30 minutes after alcohol has been injected through tube. Samples of gastric contents are withdrawn at stated intervals.	Collect specimens 15 minutes after histamine and 30 minutes after histamine. Label specimens with time and "Following Histamine." Take specimens to laboratory. Receive report, staple to form 514. *Watch for reaction to histamine.* Toxic reactions: Urticaria, headache, sweating, drowsiness, dizziness, severe dyspnea. Antidote: Adrenalin.	30 minutes after histamine-free hydrochloric acid 40° to 140°.
E. *Discharge from wounds or cavities:* 1. Smear.	Sterile slides. Sterile applicator. 2 rubber bands. Request form 514–K.	Open package of slides; wrap rubber band around the end of 1 slide. With sterile applicator take sample of discharge. Spread discharge lightly in center of slide. Repeat for second slide. Place both slides together, smear sides inside. Fasten slides together with rubber band. Take to laboratory with request immediately.	Make out request. Take smear or assist technician. Receive report, staple to form 514.	Negative for organisms.

Table II.—COLLECTION OF SPECIMENS—Continued

CHECK LOCAL STATION ORDERS

Specimen or test	Equipment	Method of collection	Duty of ward corpsman	Normal values
SECRETION OR EXCRETION E. *Discharge from wounds or cavities*—Continued				
2. Culture.	Sterile applicators in test tube. Note.—For throat cultures obtain special tube with special media from laboratory.	Remove cotton from tube, hold between second and third finger. Remove applicator without touching tube. With applicator take sample of discharge. Replace applicator in tube up to where it was held by the fingers. Replace cotton in tube. Take to laboratory with request immediately.	Make out request. Take culture or assist technician. Receive report, staple to form 514.	Negative for growth.
F. *Blood:* 1. Blood count: Red blood count (RBC). White blood count (WBC). Differential (DIFF). Hemoglobin (HGB).	Request form 514D. Equipment brought by laboratory technician.	Skin puncture, usually finger.	Send request to laboratory. Assist technician if necessary. Receive report, staple to form 514.	RBC. 4,500,000 to 5,000,000 per cubic millimeter. WBC. 5,000 to 9,000 per cubic millimeter. Differential: Neutrophils, 66 percent. Lymphocytes, 26 percent. Monocytes, 6 percent. Eosinophils, 2 percent. Basophils, 0.5 percent.
2. Coagulation time. Bleeding time.	Same as F1.	Same as F1.	Same as F1.	Coagulation 3 to 7 min. (Sabroze). Bleeding 3 to 6 min. (Duke).
3. Hematocrit.	Same as F1.	Same as F1.	Same as F1.	Male: 47 cc. per 100 cc. Female: 42 cc. per 100 cc.
4. Sedimentation rate.	Same as F1. May be done by ward corpsman. 10 cc, syringe. 19-gage needle. Tourniquet. Alcohol sponge. Cutler tube. Sodium citrate.	Pour sodium citrate up to first calibration on cutler tube. Withdraw 4 cc. blood by venipuncture. Mix blood and citrate. Place tube in upright position. Observe tube every 5 minutes for 1 hour: Note the calibration on tube as blood separates.	May be responsible for complete test. Record observations, record calibrations on tube.	Cutler method: Males 8 mil. per minute. Females 12 mil. per min.
5. Serological tests: Wasserman, Kahn, Kline, Widal, Other.	Request form 514D. Equipment brought by laboratory technician.	Venipuncture: 5 cc. blood is withdrawn by laboratory technician.	Send request. Assist laboratory technician if necessary. Receive report, staple to Form 514.	Negative.
6. Chemistries: Nonprotein nitrogen (NPN), urea nitrogen, glucose, uric acid, total cholesterol. cholesterol ester, total protein, albumin, globulin, chlorides as NaCl, CO_2 volume percent, calcium, inorganic phosphorus, acid phosphatase, creatinine, drug levels.	Request 514D. Equipment brought by laboratory technician. "No breakfast" sign for patient's bed.	Venipuncture: Specimen taken by laboratory technician.	Send request. Place "No breakfast" sign on bed night before test. Withhold breakfast until after blood is drawn, instruct patient. Receive report, staple to form 514. After blood is taken, heat and serve breakfast to patient.	NPN 25 to 40 mg. per 100 cc. Urea nitrogen: 10 to 15 mg. per 100 cc. Glucose: 80 to 120 mg. per 100 cc. Uric acid: 2 to 4 mg. per 100 cc. Total cholesterol 140 to 230 mg. per 100 cc. Cholesterol ester: 60 to 80 mg. per 100 cc. Total protein: 6.8 Gm. per 100 cc. Albumin 3.6 to 5.6 Gm. per 100 cc. Globulin: 1.3 to 3.2 Gm. per 100 cc. Chlorides as NaCl: 450 to 500 Gm. per 100 cc. CO_2 volume percent: 55 to 80 mg. per 100 cc. Inorganic phosphorus 3 mg. per 100 cc. Acid phosphatase: 1.5 to 4 Bodansky unit. Creatinine 0.3 to 0.8 mg. per 100 cc. Drug levels.
7. Cultures.	Request form 514K. Equipment brought by laboratory technicians.	Venipuncture: Specimen is taken under strict aseptic technique by laboratory technicians or doctor.	Same as F1.	Negative.
8. Typing.	Request form 514E.	------------------------------	Same as F1.	

Table III.—SPECIAL TESTS AND EXAMINATIONS[1]

Diagnostic test	Equipment	Method of collection	Duty of ward corpsman
A. *Body fluids:* 1. Lumbar puncture (spinal fluid).	From CDR: Sterile lumbar puncture tray. Rubber gloves. Water manometer Procaine, ½ to 1 percent. From ward: Alcohol sponges. Curved basin. Cup or jar hold specimens. Labels for test tubes. Skin disinfectant. Chair for doctor. Form 514-b; list all tests ordered by doctor.	Position of patient: Patient is turned on side near edge of bed, legs flexed on abdomen, head on chest, shoulders and hips in same vertical plane. Method: Doctor paints area with skin disinfectant, anesthetizes lumbosacral area, inserts needle into spinal canal, measures the pressure with manometer, collects specimens in test tubes. *Normal values* Appearance: Clear, colorless. Reaction: Alkaline. Specific gravity: 1.001 to 1.010. Cell count: 0 to 5. Pressure: 70 to 160 mm. water. Bacteria: Negative.	Assemble and set up equipment. Tell patient what is to be done. Place and support patient in proper position. Assist doctor. Watch condition of patient (color, pulse, respiration). Receive and label specimens. After treatment: Caution patient to remain flat in bed for 2 hours or more. Take specimens to laboratory. Receive report, staple to form 514; call to doctor's attention. Chart treatment.
2. Paracentesis (abdominal fluid).	From CDR: Sterile paracentesis tray. Rubber gloves. Procaine, ½ to 1 percent. From ward: Large rubber sheet and cover. 3- to 5-gallon pail. Technique forceps. Alcohol sponges. Skin disinfectant. Curved basin. Chair for doctor. Stool, extra pillow for patient. Form 514m (if specimen is to be collected).	Position of patient: Patient is placed in a chair or on side of bed with feet supported by stool, back supported by pillows. Method: Doctor paints and anesthetizes abdominal area, makes incision, inserts trocar, takes specimen, connects tubing to trocar, fluid drains into pail.	Assemble and set up equipment. Tell patient what is to be done. Place and support patient in proper position. Drape covered rubber sheet over patient's knees. Assist doctor. Watch condition of patient (his color, pulse, respiration). After treatment: Allow patient to rest. Measure fluid. Send specimen to laboratory if ordered. Receive report, staple to Form 514; call to doctor's attention. Chart treatment.
3. Thoracentesis (pleural fluid).	From CDR: Sterile thoracentesis tray. Rubber gloves. Procaine, ½ to 1 percent. From ward: Technique forceps. Alcohol sponges. Skin disinfectant. Chair for doctor. Stool, extra pillows for patient. Small rubber sheet and cover. Curved basin. Form 514m for specimen.	Position of patient: Sitting on side of bed, feet supported by stool, back supported by pillows, or turned on side, with backrest elevated 60°. Method: Doctor paints and anesthetizes area, inserts needle, attaches syringe, aspirates fluid, collects specimen.	Assemble and set up equipment. Tell patient what is to be done. Place and support patient in proper position. Protect bed with covered rubber sheet. Assist doctor. Keep count of amount of fluid as it is withdrawn. Watch condition of patient. (His color, pulse, dyspnea). After treatment: Allow patient to rest. Send specimen to laboratory. Measure fluid. Chart treatment. Receive report, staple to Form 514, call to doctor's attention.
4. Aspiration of fluid from joints.	From CDR: Sterile aspirating set. Rubber gloves. Procaine, ½ to 1 percent. From ward: Technique forceps. Alcohol sponges. Small rubber sheet with cover. Curved basin. Skin disinfectant. Form 514m for specimen.	Position of patient: Most comfortable, support joint to be aspirated. Method: Doctor paints and anesthetizes the area, inserts needle, withdraws fluid, collects specimen.	Assemble and set up equipment. Support joint to be aspirated. Tell patient what is to be done. Protect bed by covered rubber sheet under joint to be aspirated. Assist doctor. After treatment: Make patient comfortable. Provide support for joint. Give hypnotic if ordered and necessary. Take specimen to laboratory. Chart treatment. Receive report, staple to Form 514. Call to doctor's attention.
B. *Basal metabolism rate (BMR).*	Special BMR room or on ward in a quiet room or screened area. Request form 514m. "No breakfast" sign for patient's bed.	Test is taken by technician. Patient lies quietly in bed, breathes through BMR apparatus. Respirations are recorded on graph.	Take height, weight, age, record on request form. Send request to BMR room. Make appointment. Tell patient to remain in bed until after test in a. m. and to take nothing by mouth after 2400. Delay a. m. care and breakfast until after test. Provide transportation to BMR room. After treatment: Heat and serve breakfast. Receive report, staple to Form 514. Chart test.

[1] Sources: Naval Medical School. *Instructions for Requesting Laboratory Services*, Bethesda (NNMC) 1949.
Gulli Muller and Dorothy E. Dawes. *Introduction to Medical Sciences.* (2d Ed. Philadelphia W. B. Saunders Co.) 1948.

Table III.—SPECIAL TESTS AND EXAMINATIONS—Continued

Diagnostic test	Equipment	Method of collection	Duty of ward corpsman
C. *Endoscopies:* 1. Cystoscopy (I. V. pyelogram).	Check doctor's orders. For preparation of patient: Enema tray. Hypnotic if ordered. "No breakfast" sign for patient's bed.	Examination is done in cystoscopy room. Cystoscope is inserted into urinary bladder, ureteral catheter into fundus of kidney. Dye is given I. V. Pictures are taken.	Send request, make appointment. Preparation of patient: 1. Cleansing enema night before examination. 2. Give cathartic if ordered. 3. Omit breakfast on day of examination. 4. Give hypnotic if ordered. 5. Provide transportation (stretcher). 6. Send chart with patient. After treatment: 1. Heat and serve breakfast. 2. Force fluids. 3. Be alert for signs of pain or discomfort.
2. Bronchoscopy.	For preparation of patient: Nothing by mouth. Hypnotic if ordered. "Nothing by mouth" sign for patient's bed.	Examination is done in bronchoscopy room. Bronchoscope is inserted into trachea and large bronchi. Mucous membrane is visualized.	Send request, make appointment. Preparation of patient: 1. Nothing by mouth 4 to 6 hours before examination. 2. Give hypnotic if ordered. 3. Provide transportation (stretcher). 4. Send chart with patient. After treatment: 1. After anesthetic has worn off, heat food and serve to patient. 2. Be alert for signs of pain or discomfort.
3. Proctoscopy (follow same procedure for sigmoidoscopy).	(Check doctor's orders). For preparation of patient: Enema tray. Hypnotic if ordered. "No breakfast" sign for bed. Light supper.	Examination is done in the proctoscopy room. Proctoscope is inserted into rectum, mucous membrane is visualized.	Send request, make appointment. Preparation of patient: A. Evening before examination: 1. Light supper. 2. Cleansing enema. B. Morning of examination: 1. Cleansing enema until returns are clear. 2. Omit breakfast. 3. Give hypnotic if ordered. 4. Provide transportation (stretcher). 5. Send chart with patient. After treatment: 1. Heat and serve breakfast. 2. Be alert for signs of pain or discomfort.
D. *X-rays:* 1. Bones.	Check doctor's orders. Request Form 519A.	By X-ray machine in X-ray department.	Take height, weight; record on request. Send request to X-ray. Provide transportation if needed. Receive report, staple to Form 519A.
2. Chest: a. Routine. b. K. U. B.	Same as D 1.	A. Patient stands against machine, holds breath, picture is taken. B. Picture is taken at a 6-foot distance.	Same as D 1. Be sure female patients are in cotton pajamas.
3. Portable.	Write "Portable" at top of Form 519A.	Taken on ward by portable machine.	Send request. Assist technician as necessary. Receive report, staple to Form 519.
4. Gallbladder series (GB series) cholecystogram.	Request Form 519A. "No breakfast" sign for patient's bed. Fat-free supper evening before X-rays. Gallbladder dye from X-ray.	X-ray is taken by X-ray department. Fatty meal given (usually by X-ray department). Another X-ray is taken.	1. Fill out request, add height, weight, age. 2. Make appointment. 3. Order fat-free supper from diet kitchen. 4. Instruct patient— A. To rest as much as possible during afternoon before examination. B. To eat or drink only fat-free foods or fluids. 5. Prepare patient: A. Evening before— (1) Fat-free supper. (2) ½ to 1 hour after supper, give dye tablet with small amount water every 5 minutes until 6 tablets are taken or as prescribed by doctor. (3) Place "No breakfast" sign on bed. B. Day of examination: (1) No breakfast. (2) Provide transportation. 6. Receive report, staple to Form 519.

Table III.—SPECIAL TESTS AND EXAMINATIONS—Continued

Diagnostic test	Equipment	Method of collection	Duty of ward corpsman
D. *X-rays*—Continued 5. Gastrointestinal series (G. I. series): a. Upper.	Request Form 519A. "Nothing by mouth" sign for patient's bed.	In X-ray department: Barium is given by mouth.	1. Fill out request, add height, weight, age. 2. Make appointment. 3. Instruct patient to take nothing by mouth after 2400 and until told by X-ray department. 4. Provide transportation. 5. Receive report, staple to Form 519.
b. Lower (Barium enema).	Request Form 519A. Enema tray.	In X-ray department: Barium enema is given, intestinal tract is visualized.	1. Fill out request and make appointment as in 5DA. 2. Prepare patient: A. Cleansing enema evening before and morning of examination. B. May have light breakfast of coffee and toast. 3. Provide transportation. 4. Receive report, staple to Form 519. After examination (A and B): 1. Give food when instructed by X-ray department. 2. Patient may need enema to remove barium (doctor's order).
E. *Electrical impulses:* 1. Electrocardiograph (ECG) (EKG).	Special ECG room or bed in ward. Request Form 520.	Patient lies quietly in bed. Leads are fastened to various parts of body. Electrical impulses are recorded on graph.	Take height, weight, age; record on request. Send request, make appointment. On ward: Tell patient to remain quiet. Fold top covers to foot of bed. Loosen pajama coat. Assist technician if necessary. In ECG room: Provide transportation to room.
2. Electroencephalogram (EECG).	Special EECG room. Request Form.	Leads are fastened to various parts of head. Electrical impulses are recorded on graph.	Send request to EECG room, make appointment. Provide transportation. Receive report, place on chart.

ADMINISTRATION OF MEDICINES

Review—Applicable Sections in Chapter VII; Materia Medica and Pharmacology Chapter VIII, Pharmacy

Medicines are usually ordered by the doctor for one or all of the following reasons:

1. To promote the patient's health (example: vitamins).
2. To cure the patient's disease (example: antibiotics).
3. To relieve patient's pain or discomfort (example: narcotics).

The administration of medicines is one of the most responsible duties of the corpsman. In the administration of medicines the corpsman is expected to:

1. Carry out the doctor's order accurately, giving the right dose of the right medicine to the right patient at the right time and in the right way.
2. To observe, record, and report the effects of the medicine on the patient.

Suggested Routine for Administration[14] of Medications and Treatments

Purpose: To provide an orderly, safe and economical method of administering medications and treatments.

Equipment

Medication and treatment board.

Medication and/or treatment cards.

The board provides a visible file for all medications and treatments to be given over a 24-hour period. This board may be placed on the inside door of the supply closet next to the medicine locker, in the space between the upper and lower cabinets of the locker, or on the wall to the side of the medicine locker. The board may be made to fit the spaces available. All boards should provide:

1. Space for 25 hooks (1 for each hour and prn).
2. Space between hooks sufficient to allow use of 1½- by 3-inch cards.
3. Instructions on the use of board.

[14] Adapted from Questionnaire "Administration of Medicines." Naval Hospitals, 1951.

Medication and/or Treatment Cards

Cards are made out for medications and treatments:

1. Ordered for repeated doses at specified times.
2. Ordered prn. (Specify frequency at which dose or treatment may be safely repeated.)

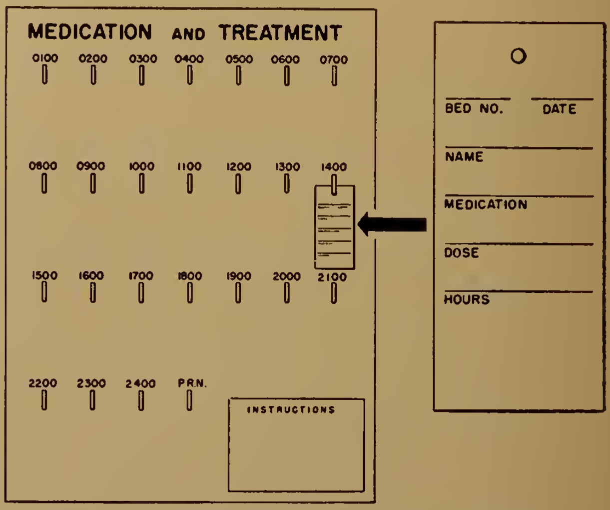


Figure 231.—Medication and Treatment Board and Card.

Cards (1½- by 3-inch) may be cut from white file cards.

Cards should include all necessary information—patient's name, bed number, medication or treatment, hours to be given, discontinue date if one is specified. (Check station orders for additional information desired on cards.)

Cards must be checked with doctor's order sheets at least twice daily—new cards made out for new orders, cards destroyed for discontinued orders. (New order for narcotics should be obtained from the doctor after 24 hours.)

Use of Board and Cards

1. Card is placed on the hook corresponding to the hour the medication or treatment is due.
2. When due, the card is removed, medication or treatment is given, and the card replaced on the hook for the hour when it is next due.

3. The medication or treatment is checked off in the nursing notes of the patient's chart after it has been given.
4. Card of prn order is placed on hook corresponding to the hour at which it may be safely repeated.
5. Card of daily order is placed face down on the same hook after it has been given.

Rules for Administration of Medication

Do

1. Do have order for medicine signed by the doctor.
2. Do know how to give the drug in the manner prescribed by the doctor.
3. Do wash your hands before preparing the medicine.
4. Do measure all dosages at eye level, whether in a glass or syringe.
5. Do prepare the medicine you give and give the medicine you prepare.
6. Do have a good light when preparing medicine.
7. Do concentrate.
8. Do know how drugs act; whether a local or systemic effect is desired and what possible bad effects might occur.
9. Do know the minimal, average, and maximal dosage of the drugs you give.
10. Do read the label three times when preparing a medicine—
    a. When removing it from shelf or drawer
    b. After pouring or preparing it
    c. When returning it to the shelf or drawer
11. Do give minims when minims are ordered, drops when drops are ordered.
12. Do use surgical aseptic technique in preparing injections and when indicated for installations and irrigations.
13. Do chart medications after you have given them.
14. Do chart the name and amount of medication and the time it was given.

Do not

1. Do not give a medicine without an order.
2. Do not allow interruptions while preparing medications.
3. Do not give when doubt exists concerning the patient, the drug or the dose. Consult your doctor or nurse in charge of the ward.
4. Do not use a medicine from an unmarked or poorly labeled bottle or container.
5. Do not return excess medicine to the stock bottle or box: discard into sink.

MEDICATION BY MOUTH

Administration

1. Acids and irons are given well diluted through a drinking tube.
2. Irons, iodides, and arsenic preparations are usually given after meals.
3. Cough medicines are given last, undiluted; instruct patient not to drink any fluids for at least 15 minutes afterward.
4. Shake liquids well before pouring.
5. Dilute liquids with ½-ounce of water unless contraindicated.
6. Give saline medications for edema in small amount of water; saline cathartics in large amounts of water.
7. Make disagreeable medicines as palatable as possible.
    a. Castor oil mixed with orange juice and 15 grains sodium bicarbonate.
    b. Add small amount of lemon juice to saline cathartics.
    c. Chill mineral oil, follow with slice of orange.
8. For young children or elderly patients, crush pill or tablet and dissolve in small amount of water; use teaspoon instead of medicine glass.

Equipment

CRM instrument tray with:
- Medicine glasses for liquids
- Souffle or paper cup for pills or tablets
- Stirring rod
- Medicine cards
- Pitcher of water
- Medicine dropper
- Paper straws or drinking tubes
- Teaspoon
- Paper wipes

Procedure

Preparation of Medicines.
Wash your hands!

Figure 232.—Equipment for Administration of Medicine by Mouth.

1. Unlock cabinet. Remove cards from board.
2. Arrange cards in sequence similar to placement of patients on ward. Stack cards so that one card is visible at one time.
3. Take first card: Locate and remove medicine from shelf.
4. Read label: Compare label with card, place card on tray.
5. Obtain medicine glass, read label: Place medicine in glass, place glass on card in tray.

Pill, tablet, capsule

If in bottle, pour required number into lid of bottle.

If in box, remove required number with spoon.

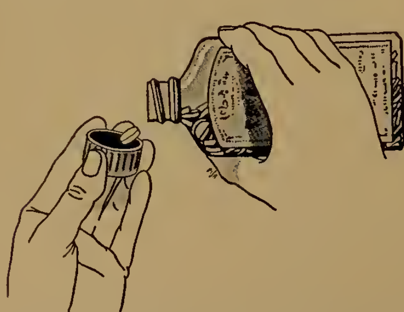


Figure 233.—Removing Tablet from Bottle.

Powder

If in paper—empty into medicine glass, add water, stir with stirring rod.

If measured with spoon, empty into medicine glass; add water, stir with stirring rod.

Liquid

Shake bottle.

Remove cap, place it inside up on shelf.

Hold medicine glass in left hand so that mark of prescribed amount is at eye level. Place thumbnail at mark.

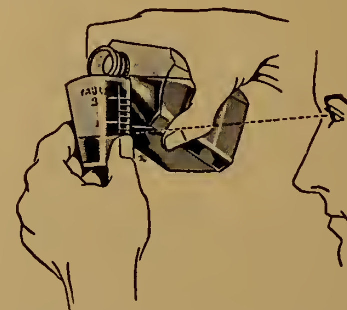


Figure 234.—Pouring Liquid Medication.

Hold bottle in right hand; label next to palm; pour designated amount.

Wipe rim of bottle with paper wipe; replace cap.

Dilute medicine with one-half ounce of water unless contraindicated.

Drops

Use medicine dropper.

Draw up approximate amount of drug from bottle.

Holding dropper at 45° angle, count prescribed number of drops into medicine glass.

Figure 235.—Correct Angle of Medicine Dropper.

Discard solution remaining in dropper into sink.

Dilute medicine with one-half ounce of water.

Minims

Use minim glass.

Follow same procedure as for pouring liquids.

6. Read label: check medicine card with label on bottle: replace bottle on shelf.
7. Repeat step 5 for remaining cards.

Administration of Medicines

1. Carry tray to ward.
2. Identify patient.
   a. Read bedtag.
   b. Check tag with medicine card.
   c. Ask patient his name; compare with card.
3. Give medicine in glass to patient.
4. Give water with medicine unless contraindicated.
5. Stay with patient until medication has been taken; do not leave medication at bedside.
6. Place medicine glass to one side of tray; turn medicine card face down on tray.
7. Repeat steps 2 through 6 for remaining medications.

After Care

1. Wash all glasses with hot soapy water; rinse. Boil glasses for 10 minutes.
2. Wash spoons, droppers, pitchers and tray.
3. Reset tray.
4. Chart medications. Return cards to board in correct order.

A wheeled cart may be used in place of tray; the set up and manner of administration remains the same.

Medication by Sublingual Route (Under the Tongue)

Medicine is in quickly dissolving pill form. The pill is placed under the patient's tongue and allowed to dissolve. No water is given.

Medication by Injection

Purpose: To produce rapid systemic effect; to produce local reaction; to administer drug which is destroyed by gastric juices or when drug cannot be taken by mouth.

Method of injection

Intradermal—into the superficial layers of the skin. Used to test for specific allergic reactions.

Subcutaneous.—under the skin. Used primarily to administer narcotics, sedatives.

Intramuscular—into the muscle. Used when drugs are not suitable for intravenous injection, when a more rapid effect is desired than could be obtained by subcutaneous method, when drug is not readily absorbed, or when it is irritating to subcutaneous tissue.

SYRINGES FOR INJECTION

All syringes must be sterile; be of correct size for the medication to be administered and be handled with aseptic technique.

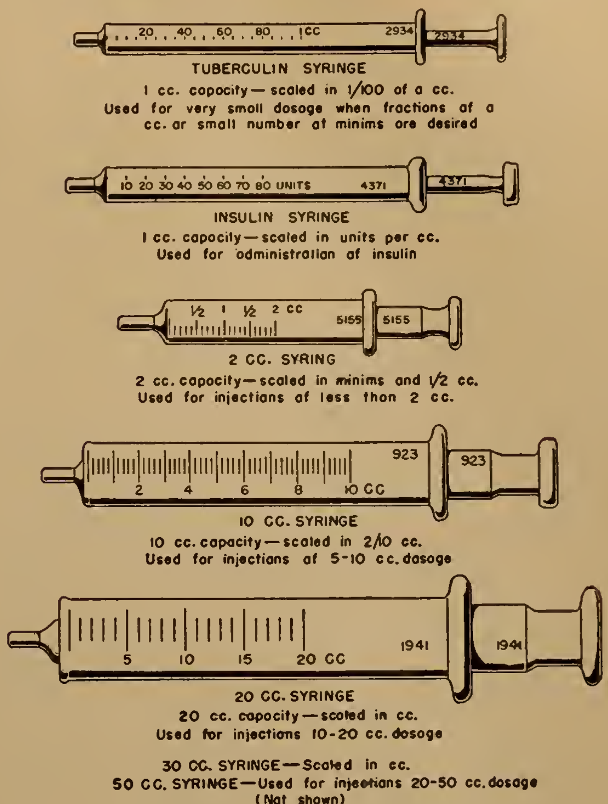


Figure 236.—Syringes for Injection.

Intravenous—into the vein. Used when very rapid effects are desired.

Intraspinous—into spinal canal. Used primarily for producing anesthesia.

NEEDLES FOR INJECTION

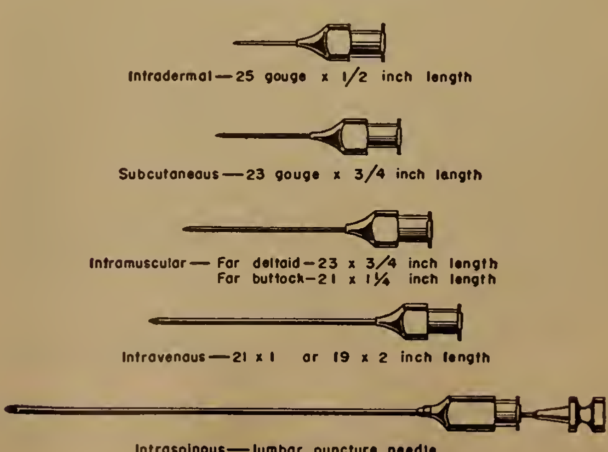


Figure 237.—Needles for Injection.

The use of autoclaved syringes and needles is required for intravenous and intraspinous injections and is strongly recommended for all injections. When autoclaved equipment is not available:

1. Boil syringe and needle for 10 minutes in sterilizer just before preparing medications.
2. When a number of injections must be prepared, set up tray for injections using syringes and needles directly from the sterilizer.
3. Maintain a hypodermic tray with sterile syringes and needles in a covered container of 70 percent alcohol or Benzalkonium chloride 1:1000 solution.[15]

Subcutaneous Injection

Equipment

Metal tray with:
- Sterile covered tray of 70 percent alcohol containing 2 cc. syringes, needles, 23g x ¾″, 21g x 1¼″, 25g x ½″.
- Sterile covered container of alcohol sponges.
- Thumb forceps in container three-fourths filled with alcohol 70 percent.
- Rubber-stoppered vial of sterile distilled water.
- Screw-capped bottle of distilled water.
- Sputum cup without cover for waste.
- Matches.
- Ampoul file.
- Alcohol lamp.

Figure 238.—Hypodermic Tray.

[15] Tests on dry sterile syringe container showed growth in 5 hours of use. Tests on sterile syringes in container of 70 percent alcohol showed no growth in 24 hours of use. Refer to station orders for local requirements.

Precautions

1. Use sterile technique in the preparation and administration of injections.
2. Rinse alcohol from syringe with sterile water before preparing medication.
3. Match numbers of syringe barrel and plunger.
4. Test needle for hooks and burrs before taking medication to patient.
5. Use a separate syringe for each injection.

Procedure

Preparation of syringe and needle

1. Using forceps, remove alcohol sponge from container; place sponge on top of distilled water vial.

2*a*. Using forceps; remove syringe barrel from container.

b. Check number on barrel; using forceps, pick up plunger having the same number; insert it into barrel.

c. Using forceps; pick up needle and attach it to the syringe.

3. With fingers, tighten the needle on the syringe.
4. Wipe top of vial with alcohol sponge; discard sponge.
5. Push plunger back and forth to expel alcohol.
6. Remove 1 cc. of water from vial.

7*a*. Rinse syringe by pushing plunger back and forth.

b. Discard water into sink.

Preparation of solution (fig. 239)

1. Using tablets not readily dissolved. (*Example:* codeine, pantopon).

Pour distilled water into spoon of alcohol lamp. Boil water 1 minute; cap lamp.

Assemble syringe and needle.

Draw desired amount of water into syringe; discard remainder from spoon.

Drop tablet into spoon; eject water from syringe over tablet until dissolved and solution is clear.

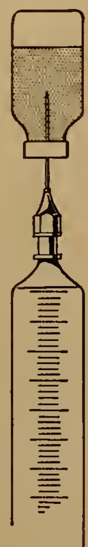
Draw all solution into syringe.

Cover needle with alcohol sponge; check point for hooks and burrs.

Take to patient.

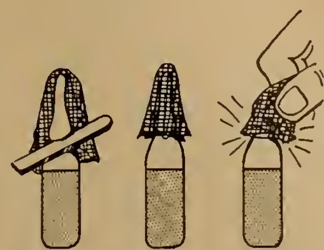
PREPARATION OF MEDICINES FOR NEEDLE (PARENTERAL) INJECTIONS

MEDICINE FROM STOPPERED VIAL



1. Cleanse stopper with alcohol sponge.
2. Assemble syringe and needle.
3. Draw back plunger of syringe to the amount of solution desired.
4. Insert needle through center of stopper, push in plunger.
5. Invert vial; pull back on plunger, withdraw desired amount; remove needle.
6. Cover needle with alcohol sponge; check point for burrs and hooks.
7. Take to patient.

MEDICINE FROM AMPOUL

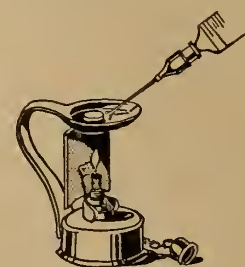


1. Wipe file and neck of ampoul with alcohol sponge.
2. File neck of ampoul.
3. Cover ampoul with alcohol sponge.
4. Break off neck of ampoul at file marks.

1. Assemble syringe and needle.
2. Tip ampoul to 45° angle.
3. Insert needle into ampoul, withdraw desired amount of solution.
4. Cover needle with alcohol sponge; check point for burrs and hooks.
5. Take to patient.

MEDICINE IN TABLET FORM

1. Pour distilled water into spoon of alcohol lamp.
2. Boil water one minute; cap lamp.
3. Assemble syringe and needle.
4. Draw desired amount of water into syringe; discard remainder from spoon.
5. Drop tablet into spoon; eject water from syringe over tablet until dissolved and solution is clear.
6. Draw all solution into syringe.
7. Cover needle with alcohol sponge; check point for burrs and hooks.
8. Take to patient.



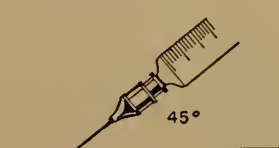
Fractional dosage
1. Work out problem on paper.
2. Follow steps 1 through 6 above.
3. Discard the necessary amount of solution as shown by answer to problem.
4. Follow steps 7 and 8 above.

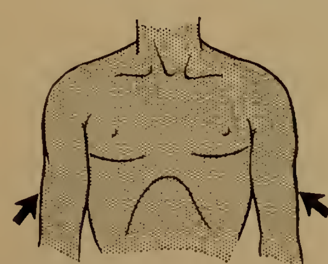
ADMINISTRATION OF PARENTERAL MEDICINES

INTRADERMAL

1. Explain to patient.
2. Swab site of injection with an alcohol sponge.
3. Hold syringe upright, expel air bubbles.
4. Insert needle at a 15° angle, just under the skin, so that a raised area is seen.
5. Inject prescribed amount of solution.
6. Cover needle with alcohol sponge, withdraw needle.

SUBCUTANEOUS





1. Explain to patient.
2. Swab site of injection with an alcohol sponge.
3. Hold syringe upright; expel air bubbles.
4. Make a firm cushion of flesh at injection site.
5. Insert needle quickly at a 45° angle.
6. Draw back on plunger; if resistance is felt and no blood seen, slowly inject solution.
7. Place alcohol sponge over needle; quickly remove needle.
8. Gently massage site of injection with alcohol sponge for one minute.

INTRAMUSCULAR

1. Explain to patient.
2. Swab site of injection with an alcohol sponge.
3. Hold syringe upright; expel air bubbles.
4. Make a firm cushion of flesh at injection site.
5. Insert needle quickly at a 90° angle.
6. Draw back on plunger; if resistance is felt and no blood seen, slowly inject solution.
7. Place alcohol sponge over needle; quickly remove needle.
8. Gently massage site of injection with alcohol sponge for one minute.

Figure 239.—Preparation and Administration of Medicine for Parenteral Injection.

2. Using tablets readily dissolved.
Remove 1 cc. of sterile water from vial.
Cover needle with alcohol sponge.
Remove plunger.
Drop tablet into barrel.
Holding barrel at 45° angle, gently insert plunger, avoid dispelling water.
With needle covered by sponge and plunger secured by fingertip, gently agitate syringe until tablet is dissolved and solution is clear.

Administration of injection (fig. 239)

1. Explain procedure to patient.
2. Swab site of injection with alcohol sponge.
3. Hold syringe upright; expel air bubbles.
4. Stretch skin taut between thumb and forefinger of left hand, grasp arm firmly at either side of site of injection, lifting up tissue to form a cushion.
5. Insert needle quickly at a 45° angle (fig. 239).
6. Draw back on plunger; if resistance is felt and blood is not seen, slowly inject solution.
7. Place alcohol sponge over needle; quickly remove needle.
8. Gently massage site of injection with an alcohol sponge for one minute.

After care of equipment

1. Rinse syringe and needle with cool water.
2. If autoclaved equipment was used, send cleansed syringe, needle and wrapper to CDR.
3. Equipment from hypodermic tray:
   a. Separate barrel, plunger, and needle.
   b. Place in sterilizer; boil 10 minutes.
   c. Return boiled syringe and needle to sterile container.
4. Discard waste; reset tray.

Daily

1. Strip entire tray; filter alcohol.
2. Wash and boil containers, syringes, needles.
3. Reset tray; refill containers with alcohol.

Fractional dosage

1. Work out the problem on paper using the formula:

$$\frac{\text{Dose on hand}}{\text{Dose desired}} \times \left(\begin{array}{c}\text{quantity of water in minims in}\\ \text{which tablet(s)}\\ \text{are to be dissolved}\end{array}\right) = \text{dose to be given in minims.}$$

Example:
If the dose on hand is larger than the dose desired:
Dose desired: Morphine sulfate $\frac{1}{6}$ grain.
Dose on hand: Morphine sulfate $\frac{1}{4}$ grain.

$$\frac{\frac{1}{6}}{\frac{1}{4}} \times \text{quantity} = \text{dose}$$

$$\frac{1}{6} \times \frac{4}{1} \times 24\text{M} = 16 \text{ minims}$$

Answer: Dissolve one ($\frac{1}{4}$ grain) tablet of morphine sulfate in 24 minims of water. Discard 8 minims—give 16 minims to patient.

Example:
If the dose on hand is less than the dose desired it will be necessary to use two or more tablets.
Dose desired: Morphine sulfate $\frac{1}{6}$ grain.
Dose on hand: Morphine sulfate $\frac{1}{8}$ grain.
Therefore it will be necessary to use 2 tablets.

$$\frac{\frac{1}{6}}{\frac{1}{8} \times 2} \times 24$$

$$\frac{\frac{1}{6}}{\frac{2}{8} = \frac{1}{4}} \qquad \frac{1}{6} \times \frac{4}{1} \times 24 = 16 \text{ minims}$$

Answer: Dissolve two ($\frac{1}{8}$ grain) tablets of morphine sulfate in 24 minims of water; discard 8 minims, give 16 minims to patient.

INTRAMUSCULAR

Prepare solution and administer medication as illustrated in figure 239.

INTRAVENOUS [16]

1. Prepare solution as required by packaging. Use 19-gage, 2-inch needle.
2. Take prepared syringe and tourniquet to patient.
3. Select site of injection; place tourniquet under arm above site.
4. Tighten tourniquet; doctor will insert needle.
5. When blood appears in the syringe, loosen tourniquet.
6. Doctor will inject solution.
7. Place alcohol sponge over needle; doctor removes needle.
8. Flex patient's arm; hold alcohol sponge over site for a few seconds.

---

[16] Corpsman is not responsible for intravenous injections of medicine. If in an emergency he is required to do so, the angle of injection is the same as illustrated under venipuncture illustration in laboratory section (Plate XI). Strict aseptic technique must be used.

INTRASPINAL

Procedure

1. The preparation of equipment and patient is same as for lumbar puncture. (See p. 201.)
2. Preparation of solution depends upon packaging; follow instruction as applicable.

SPECIAL MEDICINES FOR INJECTION

INSULIN—types of insulin

Regular or standard insulin is available on the supply table in 10 cc. vials of two strengths; 20 units in each cc.; 40 units in each cc.

Protamine zinc insulin is available in 10 cc. vials of 40 units in each cc.

Preparation of insulin—both types

1. Use a dry, sterile insulin syringe.
2. Use the measure on the syringe corresponding to the strength of the insulin. *Example:* Regular insulin U35 has been ordered:

   Locate the U40 scale on the syringe.

   Obtain U40 per cc. strength insulin.

   Withdraw insulin from the vial down to the U35 mark on the U40 scale of the syringe.
3. Regular insulin should be clear and colorless.
4. Protamine zinc insulin is in suspension and the vial must be rotated before use.

Administration

1. Insulin is given subcutaneously in the same manner as other hypodermics.
2. Change the site of injection each time a dose is given. Use both upper arms and anterior thighs in rotation.
3. Give the insulin at the correct angle of injection. Avoid too deep or too shallow injections.
4. Time of administration
   a. Regular insulin—20 minutes before meals.
   b. Protamine zinc—once daily.

Precaution: When both types are ordered to be administered at the same time, use a separate syringe for each type.

Medicines in oil

1. Warm solution in water bath.
2. Use a large bore needle (18g) to remove solution from the ampule or vial.
3. Give medication as an intramuscular injection into the buttocks.

Antibiotics

1. Use autoclaved or boiled syringes and needles whenever possible.
2. If syringe has been in alcohol, rinse thoroughly with sterile distilled water before taking up an antibiotic. Alcohol destroys the effectiveness of the antibiotic.

MEDICATION BY INHALATION

May be in the form of gases or volatile drugs and are given for their local or systemic effect.

Steam inhalation

Purpose: To provide moist heat and relieve congestion in upper respiratory passages.

Method I

Equipment

Vaporizer
Medication if ordered
Water
Bath towel

Precautions

1. Prevent burning the patient. Keep vaporizer 12 to 18 inches away from patient.

Figure 240.—Steam Inhalation. Croup tent may be made by draping blanket over two irrigating stands.

2. Do not wash vaporizer under running water; the electrical element must be kept dry.

Procedure

In utility room:

1. Fill vaporizer to water level mark.
2. Place medication as directed in instructions on vaporizer.
3. Plug in vaporizer; allow water to boil. Take to bedside.

At bedside:

1. Bring patient to side of bed.
2. Place bath towel around patient's head.
3. Plug in vaporizer; turn spout so that steam is directed toward the patient.
4. Ask the patient to open his mouth and take deep breaths.
5. Treatment should last about twenty minutes.

After treatment:

1. Dry patient's face.
2. Prevent patient's being chilled. Caution him to stay inside ward until at least one-half hour after treatment.

Method II

Equipment

Wash basin
Pitcher
Paper bag
Bath towel
Towel
Medication
Boiling water

Precaution: Patient must not touch pitcher; ask him to keep his hands at his side.

Procedure

1. Place pitcher in basin.
2. Cut hole in bottom of paper bag to fit over the mouth and nose of the patient.
3. Pour boiling water into pitcher.
4. Take to bedside.
5. Have patient place his mouth and nose over hole in paper bag.
6. Drape bath towel over patient's head and over the pitcher.

Figure 241.—Steam Inhalation by Pitcher Method.

7. Ask patient to open his mouth and take deep breaths.

See "Administration of oxygen and other gases" for other methods of mediciation by inhalation.

MEDICATION BY RECTUM

Medications may be administered by means of retention enemas or suppositories.

Purpose: To produce a local or systemic effect.

Indicated: In presence of nausea or vomiting; when administration by mouth is impossible; when drug is unpalatable.

Retention enema:

Total quantity of fluid should not exceed 120 cc.

Irritating drugs such as paraldehyde and sodium salicylate are best given in a thin solution of corn starch. See procedure for retention enema (pp. 239–240).

Suppository

Drug is mixed with a solid which melts at body temperature.

Equipment

1. Prescribed suppository.
2. Finger cot or rubber glove.
3. Lubricant.
4. Toilet tissue.

Take equipment to bedside in curved basin.

Procedure

1. Screen patient; ask or assist him to turn on his side.
2. Expose rectum.
3. Put on glove or finger cot (index finger).
4. Lubricate glove.
5. Introduce suppository gently into rectum and advance it as far as possible. If patient has difficulty retaining suppository, apply pressure over rectum until the desire to defecate has passed.
6. Remove glove; place in curved basin.

In utility room

Wash and boil basin and glove.
Discard finger cot.

LOCAL APPLICATIONS OF MEDICATIONS

Medications may be applied locally in the form of lotion, ointment, or paste.

Lotion—Equipment

1. Shallow dish.
2. Cotton pledgets.
3. Prescribed lotion.

Procedure

1. Pour lotion into shallow dish.
2. Apply lotion to area, using cotton.

Ointment and paste—Equipment

1. Prescribed ointment or paste.
2. Tongue blade or spatula.
3. Gauze or soft muslin.
4. Bandage or binder.

Procedure

1. With tongue blade, remove ointment from container.
2. Spread a thin layer of ointment on gauze.
3. Apply coated gauze to area.
4. Secure with bandage or binder.

NOTE.—When applied to wound, sterile articles must be used and aseptic technique maintained.

ADMINISTRATION OF OXYGEN AND OTHER GASES

Review—Chapter II, "The Respiratory System"
Chapter VI, "Safety"

THE ADMINISTRATION OF OXYGEN [17]

Purpose: To make an extra supply of oxygen available to the patient.

Indicated: In conditions of anoxia (lack of oxygen) and anoxemia (lack of oxygen in blood). Some symptoms of anoxia are cyanosis and dyspnea, rapid thready pulse and restlessness. Oxygen is used as a supportive measure for patients with pneumonia, asthma, cardiac failure, decompensation, thrombosis, and shock; and is sometimes used for postoperative patients.

SAFETY RULES IN USE OF OXYGEN

In storerooms

Oxygen Cylinders

1. Keep cylinders secured (strap, chain) in upright position in a separate place away from oil, grease, gasoline, matches, alcohol, ether; from heating equipment, boilers, furnaces, radiators, steam pipes, sterilizers, autoclaves.
2. Have storage space well posted with "Oxygen—No Smoking" signs.
3. Keep caps on all cylinders.
4. Have separate and clearly marked place for storing full and empty cylinders.
5. When removing cylinder from storeroom, remove cap, open and close valve quickly. This is called "cracking" the valve. Replace cap.

Figure 242.—Cracking the Valve.

[17] Adapted from *Oxygen Therapy Handbook*. Linde Air Products Co., 1943. New York.

Regulators

1. Store in closed cabinets.
2. Label all regulators with tags "Do Not Oil or Grease."
3. Test regulators frequently for leaks and liter flow accuracy.
4. Do not attempt to repair regulators; return regulators to issue room.

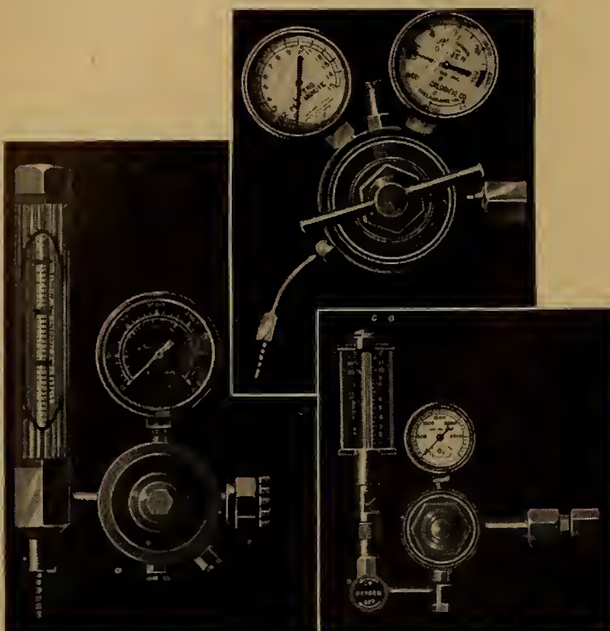


Figure 244.—Types of Regulators.

Oxygen tent motors

1. Store in cool, clean dry rooms.
2. Use muslin dust covers (may be made in the sewing rooms) to keep motors clean.
3. Set up and test motor operation at regular intervals every 2–3 weeks.

On ward

1. Post "Oxygen—No Smoking" signs at the entrance to the ward, room or unit.
2. Strap oxygen cylinder to bedpost or to carrier to keep it in an upright position. Cylinder should be placed away from radiators.
3. Instruct all patients and visitors not to smoke within the area.
4. Always have an extra cylinder of oxygen on hand to assure patient a continuous supply. Watch usage rate of oxygen.

Table IV.—APPROXIMATE REMAINING HOURS OF SERVICE IN STANDARD 244-CUBIC FOOT AND 220-CUBIC FOOT CYLINDERS OF U. S. P. OXYGEN [1]

Examples: Full cylinder, at 2,200-pound pressure, flowing at rate of 6 liters should last approximately 19 hours. A cylinder with 1,000-pound pressure flowing at a rate of 8 liters per minute should last 6 hours.

Rate of flow in liters per minute	244 cubic feet; 2,200 pounds; 6,900 liters	220 cubic feet; 2,000 pounds; 6,200 liters	165 cubic feet; 1,500 pounds; 4,650 liters	110 cubic feet; 1,000 pounds; 3,100 liters	55 cubic feet; 500 pounds; 1,550 liters
	Hours	*Hours*	*Hours*	*Hours*	*Hours*
1	28	25	19	12	6
6	19	17	12	8	4
8	14	12	9	6	3
10	11	10	7	5	2
12	9	8	6	4	2
14	8	7	5	3	1
16	7	6	4	3	1

[1] Ohio Chemical & Surgical Equipment Co., 1400 East Washington Ave., Madison, Wis.

5. When an oxygen tent is in operation:
   Do not use electrical devices (call bells, heating pads, vaporizers) inside tent.
   Do not use alcohol or ether inside tent.
   Keep patient clothed in cotton material; wool and nylon are dangerous because of their static electrical properties.
6. Mark cylinders before returning them to storeroom. When empty:
   Remove regulator.
   Close valve; replace cap.
   Label cylinder "empty." Use shipping tag or piece of adhesive tape.

Figure 246.—A. B. C. D. Attaching Regulator to Cylinder.

7. To attach regulator to cylinder:

Remove cylinder valve cap. Insert regulator inlet into cylinder valve outlet and tighten inlet nut with wrench (fig. 246a).

IMPORTANT! Before opening (fig. 246b) cylinder valve, always loosen regulator flow adjusting knob.

Open cylinder valve *slowly* until needle of cylinder gage stops moving (fig. 246c).

Turn flow adjusting knob until desired rate of flow shows on flow indicator gage (fig. 246d).

Figure 247.—A. B. C. Disconnecting Regulator and Cylinder.

8. To disconnect regulator, cylinder:

Close valve tightly. (fig. 247a)

Wait until both cylinder and flow gages have registered zero. (fig. 247b)

Loosen flow adjusting knob. Unscrew inlet nut. Remove regulator. Recap cylinder. (fig. 247c)

Methods of Administration

The method of administrating oxygen is selected by the doctor. He may order oxygen to be given through a nasal catheter, by face mask, or by the tent method.

Mental preparation of patient for all methods.—The patient is able to obtain maximum benefit from oxygen only when any fear, anxiety or suspicion existing in patient's mind is relieved. Explain, reassure, and demonstrate what is to be done, how it will relieve him, and what he must do to get the best results.

Nasal Catheter Method

Equipment

Oxygen cylinder flow gage (regulator), humidifier.

Lubricant and tissue.

Four feet of rubber tubing.

Catheter (8–14 French) with extra holes as near tip as possible.

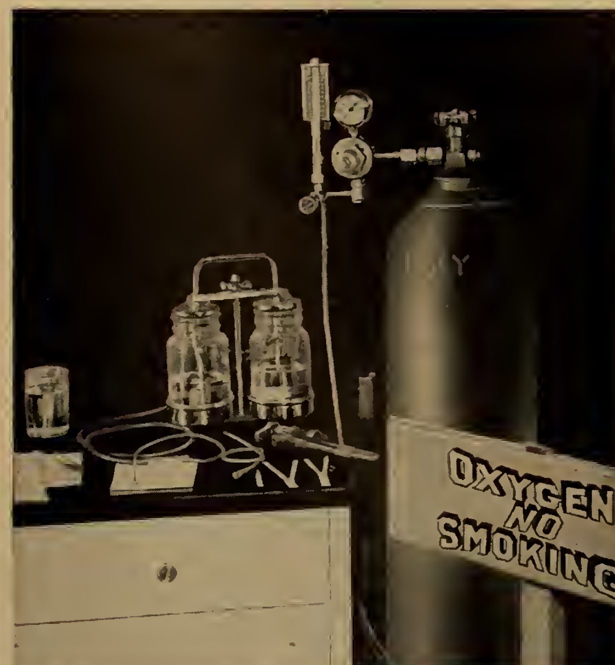


Figure 248.—Equipment for Naval Catheter Method.

Connector (from tubing to catheter).

Rubber band and safety pin.

Wrench.

Glass of water.

Adhesive—1 small piece to mark catheter. Two 6-inch strips of one-half inch width split half way down.

Procedure

Preparation of equipment in utility room

1. Open and close valve of oxygen cylinder.

2. Using wrench, attach regulator and humidifier to cylinder.

3. Attach tubing to humidifier.

4. Select largest sized catheter that can be inserted comfortably in patient's nose.

5. Attach catheter to tubing with connector.

Figure 249.—Measuring Catheter.

Preparation of patient

1. Tell patient how and what you are going to do.

2. With the catheter, measure the distance from the tip of the patient's nose to the lobe of his ear; mark this point on the catheter with a small piece of tape.

3. Turn valve on oxygen cylinder and adjust flow on regulator to 5–6 liters per minute.

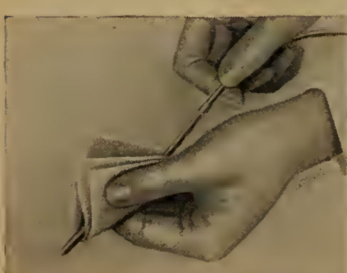


Figure 250.—Lubricating Tube.

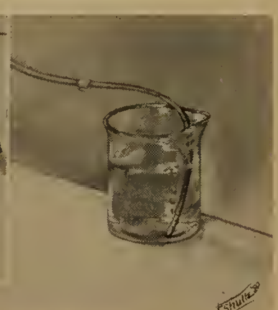


Figure 251.—Testing Patency of Tube.

4. Place small amount of lubricant on tissue; pass catheter lightly through the tissue.

5. Hold tip of catheter in glass of water to be sure holes are not plugged. (Fig. 251.)

6. Holding the catheter at the taped mark, rotate and find when its tip hangs at lowest level.

7. Holding catheter in this position and with the oxygen flowing, insert the catheter into patient's nose slowly up to the taped mark.

8. Ask the patient to open his mouth; the tip of the catheter will be seen opposite the uvula.

9. Tape catheter firmly at tip or side of nose and forehead.

Figure 252.—Find the Droop of Catheter.

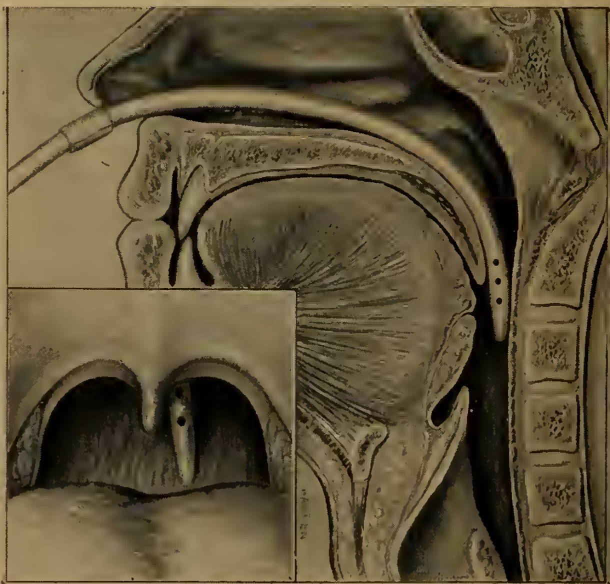


Figure 253.—Position of Catheter.

Figure 254.—Taping Catheter in Place.

10. Loop elastic band around tubing and pin to bedding, leaving enough tubing to allow patient to move about in bed.

Care of patient with nasal catheter

1. Apply vaseline, cold cream or mineral oil about nostril every 4 hours and prn.
2. Give mouth care every 4 hours.
3. Give fluids frequently.
4. Watch patient; if he shows signs of restlessness, dyspnea, cyanosis, check supply and flow of oxygen and the water level in humidifier. Check opening of catheter.
5. Always have a clean catheter ready at bedside.
6. Catheter should be changed every 12 hours and more frequently if nasal secretions make it advisable. Use alternate nostrils each change.

Care of catheters after use

1. Wash catheters; boil 5 minutes.
2. Return to proper department.

Face Mask (B. L. B.) Method

Equipment:

1. Mask.
2. Oxygen cylinder, regulator, water bottle (humidifier).
3. Wrench.
4. Four feet of rubber tubing and connecting tip.
5. Rubber band, safety pin.

Procedure:

In utility room

1. "Crack" valve of oxygen cylinder.
2. Connect regulator, humidifier, tubing and mask.

At bedside

1. Strap cylinder to bedpost.
2. Turn on oxygen 6–10 liters per minute.
3. Tell patient what you are going to do.
4. Apply mask to patient's face. Ask him to exhale as it is applied.
5. Adjust the head band so that the mask fits snugly but not too tightly.
6. Reduce liter flow to 6–8 per minute (or rate ordered by doctor) *after* patient is accustomed to the mask.

Figure 255.—Face Mask in Position.

7. Loop elastic band around tubing and pin to bed. Be sure tubing is long enough to allow patient to move about in bed.

Care of patient with mask

1. Every 1½ to 2 hours:
   Remove mask to sponge and dry patient's face and inside of mask.
   Give fluids to drink.
   Apply powder to patient's face if needed.
   Re-apply mask.
2. Watch rebreathing bag; it should expand when patient exhales and deflate when patient inhales.
3. Oxygen concentration is controlled by liter flow.
   For 100 percent oxygen concentration, adjust liter flow to 6 to 8 per minute so that bag never completely collapses during inspiration.
   For 50 to 80 percent oxygen concentration, adjust flow to 5 to 6 liters per minute so that bag collapses during inspiration.
   For 40 to 50 percent oxygen concentration, adjust flow to 4 to 5 liters per minute so that bag collapses during inspiration.
   Patient should be comfortable with no dyspnea, cyanosis; pulse should be slower and of better quality. If he isn't comfortable, check

oxygen supply, mask for leakage about nose and/or mouth. Small piece of gauze or cotton over bridge of nose or on chin may be necessary to prevent leakage.

Care of mask after use

1. Take mask apart.
2. Wash all parts of mask thoroughly with soap and warm water; rinse. Wrap mask in cloth or gauze; boil 5 minutes.
3. Dry and reassemble mask; return to proper department.

Tent Method

Equipment

1. Tent canopy.
2. Oxygen machine.

 Iceless type—does not require ice and has own electrical air conditioning device.

 Ice type—requires ice (size of grapefruit) in cooling chamber, pail to catch water from melting ice.
3. Oxygen cylinder, regulator.
4. Wall thermometer to hang inside tent.
5. Hand bell for patient.
6. Wrench.

Procedure

In utility room

1. Check canopy for leaks. Mend with cellutape.
2. Attach canopy to oxygen chamber. Close sleeves of canopy with clips or clothes pins.
3. Fill ice chamber.[18]
4. Attach regulator to cylinder (if regulator is part of cabinet, attach to cylinder in patient's room).
5. Fill humidifier to water level mark.

At bedside

1. Place rubber sheet between bottom sheet and mattress.
2. Place patient in a comfortable position (Fowler's position preferred).
3. Bring chamber and cylinder to the head of the bed. Strap tank to bed post away from radiator.
4. Place bath towel around patient's shoulders.
5. Check all connections; turn on oxygen to 15 liters per minute. Open shutters in chamber; place pail under drain.
6. Place canopy over upper part of bed, tucking it well under mattress at sides and back. Bring front of canopy down towards foot of bed.
7. Fold cotton sheet in fourths; place canopy within folds of sheets and tuck under mattress on both sides.
8. After 20 minutes, reduce oxygen flow to 8–10 liters per minute.

Figure 256.—Preparation of Bed and Oxygen Tent to Receive Patient.

Care of patient in tent

1. Every time tent is opened, oxygen is lost!
2. When giving a bath or changing the bed—

 Draw canopy up to patient's chin; tuck sides under pillow; increase liter flow to 12 to 15 per minute.

 Use talcum powder for back rubs.
3. When giving fluids use tent sleeves rather than opening entire canopy.
4. Watch temperature inside tent—maintain at 65° to 68° F. Protect patient's head with towel or OR cap if he complains of cold.
5. Use oxygen analyzer every 4 hours to determine concentration. Follow directions on analyzer.

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[18] Iceless type has own temperature control. Empty small drainage drawer on side of cabinet every 24 hours. Check and report any unusual sound in motor.

Figure 257.—Administration of Fluids to Patients in Oxygen Tent.

6. Watch patient carefully; he should be much more comfortable inside tent. If he isn't, check:
   Oxygen supply, temperature.
   Tent for leaks.
   Inflow tube or shutter to see that it is not covered by mattress or bedding.
7. The tent is not soundproof; do not discuss patient's condition within his hearing distance.
8. Be sure he has a hand bell and paper wipes within his reach.

Care of tent after use

1. If disposable type—discard.
2. Other types:
   Wash with warm water and soap; rinse with cool water; dry.
   Allow to air for 24 hours.
   Return to proper department.

CARBON DIOXIDE INHALATIONS (HYPERVENTILATION)

Purposes: To relieve hiccoughs. To encourage deep breathing following surgery.

Indicated: When ordered by doctor.

METHOD I: Used only when specifically ordered.

Equipment

1. Small cylinder 92 percent oxygen, 8 percent carbon dioxide.
2. Connector, 2 feet rubber tubing.

Procedure

1. Connect cylinder, connector, and tubing.
2. Turn on flow of gas.
3. Hold tube 6 inches from patient's face.
4. Deep breathing should occur in 30 seconds.
5. Caution! If deep breathing does not occur within 1 minute, the administration should be stopped, for serious depressant effects are likely to follow.

METHOD II: Paper bag method
(See "Postoperative Discomforts.")

Nebulizer Therapy

Purpose: Local application of medication to the respiratory tract.

This method is used only when aqueous solution of medication is to be employed.

Equipment

1. Oxygen cylinder.
2. Flow regulator.
3. Rubber tubing, 3 feet.
4. Nebulizer.
5. Aqueous solution ordered.

Figure 258.—Nebulizer in Use.

Procedure

1. Assemble oxygen tank and regulator as for oxygen therapy. Set flow to 4 liters.
2. Place drug in nebulizer.
3. Connect nebulizer to tubing.
4. Have patient insert nebulizer tip in his mouth, caution him to keep his lips closed about tube.
5. Treatment lasts approximately one-half hour or until all medication is used.

CAUTION! For safety's sake use a hand nebulizer when oily solutions are ordered to be administered.

THE ADMINISTRATION OF PARENTERAL FLUIDS

Review—Chapter II, "The Blood and Blood Vascular System"

Chapter III, "Plasma and Plasma Administration"

Chapter X, "Blood Grouping and Matching"

The average intake of fluids by a normal individual of average size is about 3,000 cc. This intake consists of the fluid taken as fluid, the fluid taken in solid foods, and the water given up as a result of oxidation. The average output of fluid is about the same. This output is that excreted by the kidneys in the form of urine, that lost by the skin through evaporation, and that lost by the lungs through the expiration of air. Fluid is lost by the digestive tract in the form of feces. During illness fluids may also be lost through vomitus and hemorrhage.

When a large amount of fluid is lost by the body, it must be replaced. Ordinarily, adequate fluid intake may be maintained by fluids taken by mouth. When a patient is unable to take sufficient fluids by mouth or when his fluid loss has been so great that his intake must be supplemented, fluids are administered by other methods. The doctor may decide to supply fluid by gastric gavage, retention enema, hypodermoclysis, intravenous infusion, or transfusion. See "Procedures Relating to Gastrointestinal Tract" for gavage and retention enema procedures.

The administration of fluids by hypodermoclysis or intravenous methods is the responsibility of the doctor or of a person trained by him. The corpsman's role is one of assisting with these procedures. In order to intelligently assist he should know:

1. How to prepare his patient and his unit.
2. What and how to prepare necessary equipment.
3. How to assist the doctor.
4. What symptoms, reactions are expected and what danger signs may occur as a result of the treatment.

INTRAVENOUS THERAPY

Definition: Introduction of large amount of fluid into vein.

Purposes: To supply medication and fluids to body; to increase blood volume; to supply nourishment to body.

Principles

1. Only fluids specially prepared for intravenous therapy are used.
2. Intravenous therapy is administered under strict aseptic conditions and techniques.
3. Intravenous fluids are given at room temperature.
4. Use correct apparatus for the type of fluid to be given. Blood and plasma require the use of a filter (fig. 259).
5. Regulate flow of fluids as ordered by the doctor.
6. Use separate tubing for amino acids.
7. All intravenous therapy is started by doctor or trained assistant under direct supervision of the doctor.
8. Know **dangers** of intravenous therapy. Reaction may be due to poor technique, too rapid administration or patient's idiosyncrasy.

   Infection—due to unsterile equipment or poor technique.

   Embolism—due to presence of air in tubing.

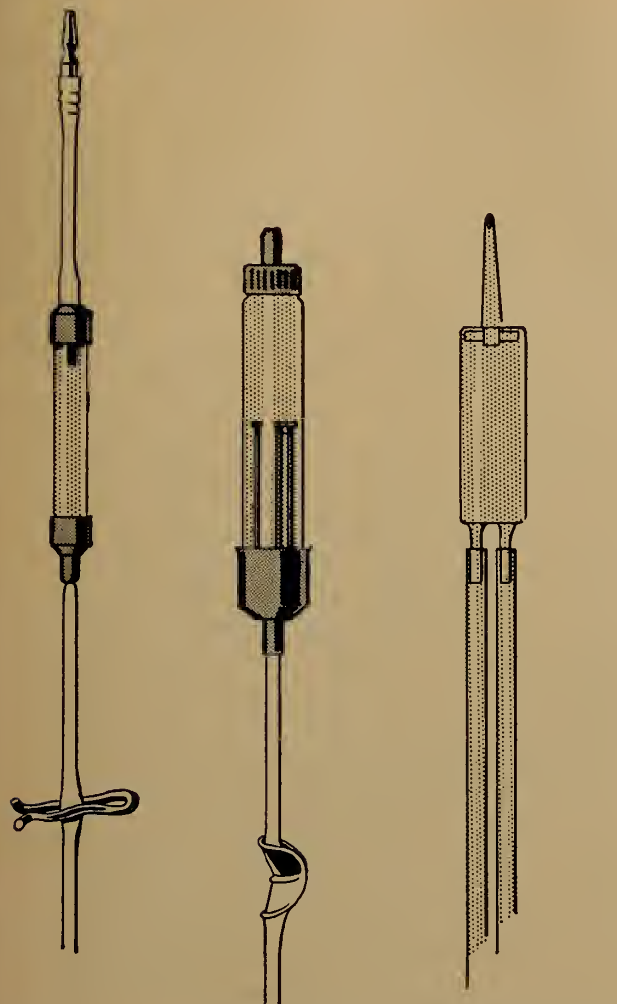

Figure 259.—Types of Drip Regulators.

Infiltration—due to needle being out of vein, causing fluid to enter tissues.

Blood—due to incompatibility and faulty cross matching.

9. **Symptoms of dangers** of intravenous therapy. Reaction may be a chill, increased pulse, respiration and temperature (spiking), vertigo, restlessness, hives, lumbar pain, dyspnea, cyanosis, nausea, and vomiting.

Infection—may be immediate or delayed. Symptoms may be same as those listed under reaction.

Embolism or blood incompatibility—sudden dramatic pain, cyanosis, dyspnea, increased pulse rate.

Infiltration—swelling and coldness at site of injection. Patient may or may not complain of pain.

10. **Treatment of dangers** of intravenous therapy.

Stop intravenous at first sign or symptom.

Notify doctor; give emergency measures. (In cases of severe cyanosis and dyspnea may include oxygen.)

In case of chill, apply extra blankets, hot water bottle to feet; give warm or hot fluids by mouth if patient is able to take them.

Send tubing and containers to blood bank laboratory for possible bacteriological studies.

Parenteral fluids may be whole blood; plasma; solutions of physiological saline; physiological saline with glucose; amino acids; buffer salts.

Sites of injections

1. Median cubital, cephalic or basilic veins.
2. Dorsalis pedis vein.

Equipment

Standard.

Solution ordered.

Container of alcohol sponges.

Curved basin.

Small covered rubber sheet.

Technique forceps in container of disinfectant solution.

Disposable intravenous set.

Correct apparatus for fluid being administered.

Arm board.

Bandage and scissors.

Adhesive tape, ½-inch width cut in 6-inch lengths.

Tourniquet.

Sterile needle pack from CDR (two gauze flats, one airway needle, one 19-gage by 1½-inch needle, screw clamp).

Preparation of Patient and his Unit

1. Explain procedure to patient, tell him how he may help.
2. Do any nursing measures required before setting-up for intravenous.
3. Offer bedpan or urinal; remove sleeve of gown from arm to be used.
4. Place small covered rubber sheet under arm and tourniquet above site of injection.

Figure 260.—Preparation of Patient for Intravenous Infusion.

5. Clear bedside stand of everything except equipment needed.

6. Place standard at foot of bed or fix pole attachment on bed.

Preparation of solution

1. Hold solution bottle up to the light. Solution should be clear without sediment or shreds of mold.
2. Remove cap (fig. 261).
3. Open needle pack; remove airway needle.
4. When airway needle is inserted, a rush of air into bottle should be heard.
5. Attach tubing—

   Place screw clamp on tubing.

   Remove protective rubber cap from tip of drip regulator; insert tip into large depression of rubber stopper of solution bottle.

   Invert solution bottle; hang on standard.

6. Holding tubing higher than bottle, remove rubber cap from needle adapter. Slowly lower tubing; allow solution to run through tubing into curved basin until entire tubing is filled with solution; all air bubbles expelled. Attach needle; clamp tubing (fig. 262).

Procedure

1. Cleanse site of injection with alcohol sponge.
2. Apply tourniquet.
3. Doctor inserts needle. When blood appears in tubing, release tourniquet and open clamp.
4. Secure needle in place with adhesive. A gauze sponge may be necessary to hold needle at correct angle of injection.

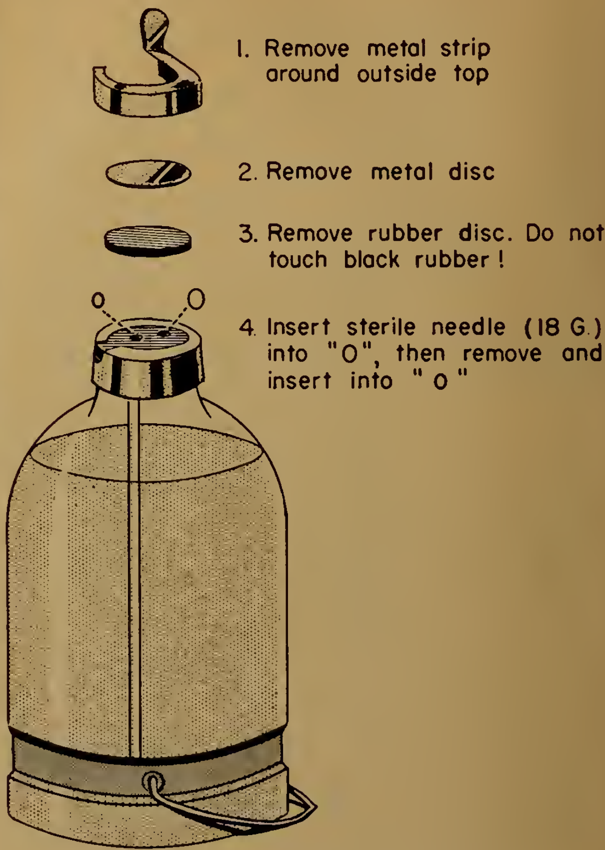

Figure 261.—Removing Cap of Solution Bottle.

5. Regulate flow 40 to 60 drops per minute or at rate ordered by doctor.
6. Watch for signs of reaction, infiltration.

Care of patient during treatment

1. Watch for any sign of the patient's being chilly or shivering. Clamp tubing immediately. Notify ward doctor or nurse at once.
2. Keep patient quiet, especially that part of body where needle is inserted. Watch for and report any swelling around needle.
3. Watch the drip regulator and report if fluid stops flowing.
4. Take pulse frequently; watch color of patient.

Care of patient after treatment

1. When solution bottle is almost empty—

   Clamp tubing.

   Remove adhesive.

   Place alcohol sponge over needle.

   Withdraw needle; exert pressure over site of injection until bleeding stops.

Figure 262.—Preparation of Solution.

2. Straighten patient's clothing and bedding; make patient comfortable.

3. Take all equipment to utility room.

Care of equipment

1. Discard tubing.

2. Rinse needle with cold water; wash with warm soapy water; rinse. Use cotton applicator to clean hub of needle.

3. Return bottle and needle pack to CDR.

Chart—Nursing Notes

1. Time of start and completion of intravenous.
2. Amount, solution, and by whom started.
3. Any reaction noted.
4. Signature.

Hypodermoclysis

Definition: Slow introduction of a large amount of fluid into the subcutaneous tissue.

Fluids: Normal saline (physiological saline); Glucose 2 to 5 percent in normal saline.

Purpose: To supply body with fluids; to restore fluid balance; to supply fluids to the body when intravenous is contraindicated.

Sites of injection

1. Anterior aspect of the thighs.
2. Subcutaneous tissue under breasts.

Equipment

1. Sheet.
2. Standard or pole attachment on bed.
3. Container alcohol sponges.
4. Technique forceps in container of disinfectant solution.
5. Disposable hypodermoclysis set; solution.
6. Package of sterile towels.
7. One-half inch adhesive tape cut in 6-inch lengths.
8. Sterile needle pack from CDR (two gauze 4 x 4, 1 airway needle, two 18-gage 3-inch needles, two screw clamps).

Preparation of patient and his unit

1. Explain procedure to the patient; tell him how he may help.
2. Do any nursing measures required before setting up hypodermoclysis.
3. Clear top of bedside locker of everything except the equipment needed.
4. Place standard at foot of the bed or fix pole attachment on the bed.

Preparation of solution

1. Same as for intravenous infusion.
2. Apply screw clamp to each tube.
3. Attach 18-gage needle to each tube.

Procedure (injection site—anterior aspect of thighs)

1. Fold back bedclothes to patient's knees.
2. Place a sheet over patient's body, exposing only thighs.
3. Cleanse site of injection with alcohol sponges.
4. Fold sterile towel over bedclothes at patient's knees.
5. Doctor inserts a needle into subcutaneous tissues of each thigh.

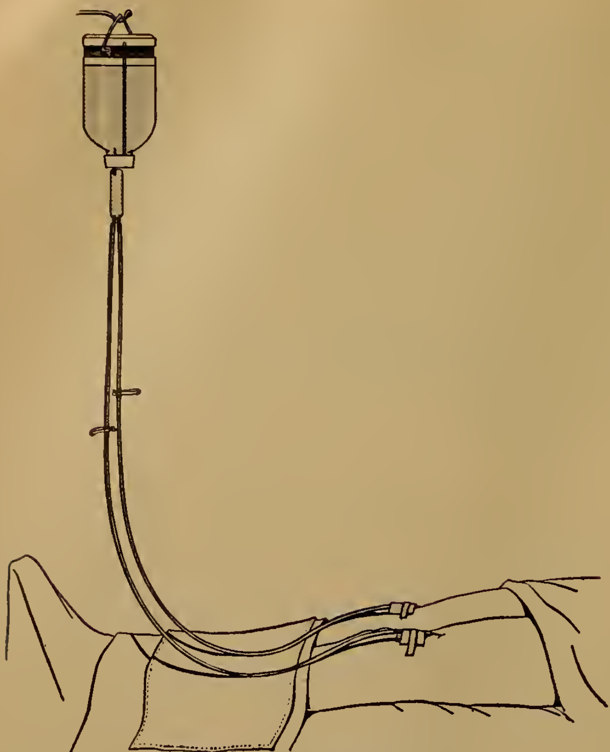

Figure 263.—Hypodermoclysis.

6. Open clamps; regulate flow to 40 drops per minute or rate ordered by doctor.
7. Place sterile 4 x 4's over needles; hold in place with adhesive tape.
8. Place a sterile towel over field.

Care of patient during treatment

1. Watch the site of injection. If area becomes hard, blanched and/or painful, stop flow until the fluid is absorbed and then open clamp.
2. When solution has been given, clamp tubing; remove needles and cover site of injection with dry sterile dressings.

Care of patient after treatment

1. Place patient in a comfortable position, preferably other than the one he has maintained during the treatment.
2. Take all equipment to utility room.

Care of equipment

1. Discard tubing.
2. Rinse needles with cold water; wash with warm soapy water; rinse. Use cotton applicators to clean hubs of needles.
3. Return bottle and needle pack to CDR.

Charting—Nursing notes

1. Time of the start and completion of the hypodermoclysis.
2. Amount, solution, and by whom started.
3. Condition of site of injection on completion of treatment.
4. Any other reactions noted.
5. Signature.

APPLICATIONS OF HEAT AND COLD

Review—Chapter II, "The Blood and Blood Vascular System"
"The Lymph and Lymph Vascular System"
"The Skin"
"The Nervous System"

The applications of heat and cold as described in this section will be limited to those procedures you will be likely to use on the ward or in sick bay. There are many other methods (lamps, diathermy, etc.) of applying heat and cold that are administered by the physical medicine department.

The effects of heat and cold

Heat expands; cold contracts. When two objects of different temperatures come in contact, heat is lost to the cooler object. When moisture is present the effects are more penetrating. In the application of heat and cold to the body the same effects occur.

The form of application, the temperature at which it is to be applied, and the duration of the application, will be prescribed by the doctor.

General instructions

1. Always have a doctor's order for all applications of heat and cold.

EFFECTS OF COLD
Capillaries constrict. Less blood flows to the part. Circulation is lessened. Pain is relieved (anesthetic effect).

NORMAL
Figure 264.—Effects of Heat and Cold.

EFFECTS OF HEAT
Capillaries dilate. More blood flows to the part. Circulation improves. Pain is relieved. Draining is promoted.

2. Always explain the procedure to the patient.

3. Always screen the patient when applying moist heat or cold.

4. Always wash your hands before starting procedures.

5. Always have a layer of cotton, flannel, or woolen cloth between the patient and any rubber or plastic materials.

6. Always watch the patient's skin closely for signs of redness, mottling, edema, or maceration.

7. Always chart procedure, noting:

Time of application.

Form of application.

The area to which it was applied.

The duration of the application.

The name, strength, and temperature of solution (moist applications).

The local and/or the systemic effects noted.

Your signature.

APPLICATIONS OF DRY HEAT

Dry heat may be applied to the body by means of a heat cradle, an electric pad, or a hot water bottle.

Purpose: To provide warmth and comfort; to relieve pain; to soothe and relax superficial tissue.

Heat Cradle

Heat cradles are frames of various sizes equipped with electric light bulb(s) or heating element to provide warmth to the patients with circulatory disturbances or extensive burns.

Precautions

1. Check all electrical connections and wiring before using cradle.

2. Be sure the cradle is large enough to cover the affected area and to permit the patient to move without being burned.

3. Secure the cradle to the bed to prevent it from slipping down over the side and burning the patient.

4. Note the temperature inside the cradle. Those having heating elements are controlled by thermostats. For those having electric light bulb(s):

Suspend a wall thermometer inside the cradle.

Control temperature by turning bulb(s) on and off. (The usual desired temperature inside the cradle is 90° to 95° F.)

5. Electric light bulbs should be 25 watt or less and covered by shields.

Electric Pad

Precautions

1. Check connections and wiring before using.
2. Keep temperature control on "low."
3. Do not use with wet applications.

Hot Water Bottle

Equipment

1. Hot water bottle and cover.
2. Pitcher of water 120° F.

Procedure

1. Test bottle for leaks.
2. Fill bottle one-half full.
3. Place bottle on flat surface; press from bottom of bottle until water appears in neck of bottle. Close tightly.
4. Wipe dry; test for leaks; place cover on bottle.
5. Apply bottle to prescribed area with neck of bottle away from patient's body.

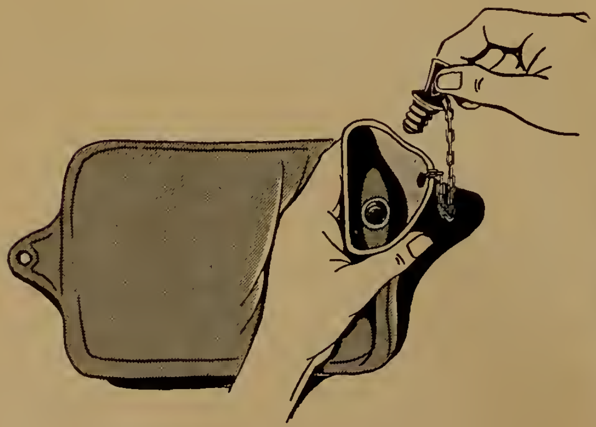

Figure 265.—Filling Hot Water Bottle.

Precautions

1. Always cover bottle.
2. Refill as necessary to keep hot.
3. Observe patient's skin frequently for signs of redness, blistering, and pain.

APPLICATIONS OF MOIST HEAT

Moist heat may be applied to the body by means of wet compresses, packs or baths. Irrigations and inhalations are also methods of applying moist heat and are discussed in detail elsewhere in the text. The purposes of applying moist heat are:

1. To relieve inflammation.
2. To provide comfort.
3. To relieve pain.
4. To hasten the localization of infection.

Moist Hot Compresses (Clean)

Purpose: When moist heat is desired for a small area.

Equipment

Tray.
Hot plate.
Basin of water or solution (105° F.).
Compress of sufficient size to cover area—may be gauze or flannel or a wash cloth.
Emesis basin.
Rubber sheet and cover.

Procedure

1. Place compresses in basin of solution on hot plate. Turn on hot plate.

Figure 266.—Moist Hot Compresses.

2. Place covered rubber sheet under part to be treated.

3. Wring out excess solution; place compress on part.

4. Repeat step 3 every 1 to 2 minutes for 20 minutes or for prescribed length of time.

Precautions

1. Wring compresses dry as possible before placing on patient.

2. Observe skin carefully for redness, pain, and blistering.

3. Keep hot plate on "low" after once heated.

Sterile Hot Wet Compresses

Used when open lesion or wound is present.

Equipment

Tray.
Hot plate.
Sterile basin and solution (105° F.).
Sterile compresses, gauze.
Two sterile forceps.
Curved basin.
Rubber sheet and cover.

Procedure

Wash Your Hands!

1. Place covered rubber sheet under part to be treated. Turn hot plate to "low."

2. With forceps, place sterile compresses in basin of solution on hot plate.

3. With sterile forceps, wring out excess solution; apply slowly to part.

Figure 267.—Sterile Hot Wet Compresses.

4. Repeat step 3 every 1 to 2 minutes for 20 minutes.

Precautions

1. Start compresses at low temperature (105° F.) to allow patient to become accustomed to them.

2. Maintain aseptic technique.

3. Watch closely for signs of burning (redness, blisters, pain).

4. Wring out compresses as dry as possible.

5. Keep hot plate on "low."

6. If infection and discharge are present, use each compress once only.

7. If for both eyes, use separate set-ups for each eye, wash hands between and after eye treatments.

Local Packs

Local packs are used to provide moist heat to a large area. This is a clean procedure.

Equipment

1. Cotton flannel or pieces of old, clean blanketing.

2. Rubber sheet.

3. Sheet or bath towel for binder.

4. Vaseline or oil for skin.

5. Safety pins or bandage to hold binder in place.

6. Basin of water 110 to 115° F.

Procedure

1. Place flannel or blanketing in basin of water.

2. Place rubber sheet and binder under the part to be treated.

3. Lubricate the skin.

4. Wring out the flannel as dry as possible; apply around part to be treated.

5. Wrap rubber sheet around flannel.

6. Wrap binder around rubber sheet; pin or tie in place.

7. Change wet flannels every half-hour; note the condition of the skin. Report signs of puffiness, blisters, wrinkling, paleness of the skin.

Precautions

1. Be sure flannel or blanketing is large enough to cover area.

2. Be sure flannels are wrung out as dry as possible to avoid burning patients by steam.

3. When applying wet flannel place it gently on the part and momentarily lift the corner to allow the escape of steam.

4. When packs are ordered continuously, expose the area to the air for one-half to one hour daily to help prevent maceration of the skin.

5. Hot water bottles are occasionally used to maintain a constant heat. Place them inside the binder next to the rubber sheet. Be sure they are no hotter than 120° F.

6. When a broken skin area or a wound is present, use sterile water, sterile abdominal pads for dressings; use sterile technique.

Lay on Packs

Lay on packs may be used to provide moist heat to a large area to relieve painful muscle spasm. They are applied when the patient is in either prone or supine position. The areas to be packed and the frequencies of the packs are prescribed by the doctor.

The packs consist of three layers of material:

The inner or hot moist layer—old clean blanketing cut to fit the part to be treated.

The waterproof layer—plastic material, oiled silk or similar material cut to the same size.

The outer layer—blanketing cut slightly larger than the other layers.

Equipment

Pack machine.
Several pieces of blanketing for inner layer.
Waterproof material for middle layer.
Blanketing for outer layer.
Long handled forceps or tongs.
Bath towels.

Procedure

Preparation of equipment

1. Place pack machine in operation according to the directions on the machine.
2. Place the inner layers in top of machine.
3. Wheel machine close to bedside.

Preparation of patient and unit

1. Check the temperature of the unit (72° F.).
2. Place patient in desired position. See page 182 for proper supine or prone position. Note the supports to be used.
3. Place outer and middle layers of pack in order of use on the patient's bed near the part to which they are to be applied.

Figure 268.—Application of Lay-on Pack.

Figure 269.—Lay-on Packs showing Three Layers of Pack. Note Patient's Position.

Method

1. One corpsman removes one inner layer from machine with forceps.
2. Second corpsman receives inner layer, tests it for moisture, then gently applies it to the part. If it is too hot, the layer is raised, skin patted dry with a bath towel and the layer again applied. It is then quickly covered with waterproof material and the outer layer of dry blanketing. The three layers are then made to conform to the part being treated.

Care of the patient during packs

1. The inner layer may be changed as often as every 15 minutes, proceed as above. Have the new inner layer ready to apply before removing the outer and middle layers.

2. Watch the patient's color and pulse rate. A thready, irregular pulse, cyanosis, or pallor indicates that the pack should be discontinued.

3. Take the patient's temperature. If the temperature is high, cool sponging between packs may be necessary. An ice bag or cold compresses to the forehead may help the patient tolerate the packs.

4. Push fluids.

5. Watch patient's skin. Dry body by gently blotting with a soft towel between packs.

6. Watch the body alignment. Maintain the patient's position in good anatomical alignment.

Care of the patient after pack

1. Dry body by gently blotting with a soft towel.
2. Place patient in a comfortable position or place in position prescribed by the doctor.
3. Continue to give fluids frequently.
4. Continue to observe patient.

Precautions

1. Be gentle with the patient. If it is necessary to lift a part, lift at the joints. Avoid touching the body of the muscle.

2. Avoid burning the patient by testing inner layers for excessive moisture before applying; by raising the layer momentarily after applying it.

3. Watch patient closely for untoward reactions; i. e., change in color, increased pulse rate, profuse perspiration.

4. If patient complains of itching, place a single layer of fine gauze over the part to be treated and then apply the inner layer. If patient is allergic to wool, cotton material may be substituted.

5. In the presence of infectious disease use medical aseptic techniques (pp. 262–268). Keep pack materials separate for each patient.

6. Watch for signs of fungus growth on pack materials. Mouldy odor is one of the first signs. Blanketing used for inner layers should be washed and allowed to dry completely every 24 hours.

7. Omit outer layer when pack is applied to the chest to avoid excess weight on patient's chest.

NOTE.—If pack machine is not available, a sterilizer and a clothes wringer may be used.

If these are not available: Boil packs in a wash boiler or large basin for 20 minutes. Use improvised wringer.

Improvised wringer—Equipment

Two broomsticks or mop handles cut to 18-inch lengths.

One canvas or other heavy material 24 inches wide, 24 inches long.

Sewing needle and stout thread or sewing machine.

Method

1. Fold material lengthwise toward the center.
2. Lap over 3 inches of material at both ends and stitch.
3. Insert sticks into loop at each end.
4. With forceps, place wet blanketing inside folded material.
5. Grasp sticks and wring dry by pulling outward and twisting.

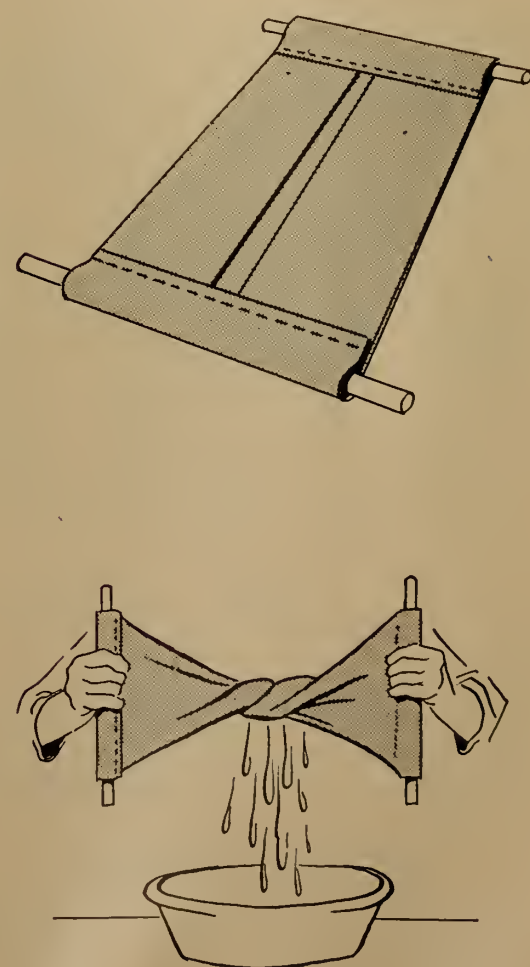

Figure 270.—Improvised Wringer.

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Hot Wet Soaks of Arm or Foot

Equipment

Foot tub one-fourth full warm water (105° F.).
Pitcher hot water (115° F.).
Rubber sheet and cover.
Bath towel.

Procedure

Wash your hands!

1. Place covered rubber sheet under part to be treated.
2. Place foot tub on rubber sheet.
3. Place part to be treated in tub.
4. Pour hot water into tub slowly, away from patient's extremity; stir water as you pour.
5. Repeat step 4 as necessary to keep water hot.
6. Continue for 20 minutes.

Precautions

1. Pour hot water away from extremity to avoid burning patient.
2. Have tub on level surface to avoid spilling water.
3. Cover top of tub to hold in heat.
4. Watch skin carefully for signs of burning.

Sitz Bath

Used in treatment of rectal, perineal, or pelvic conditions.

Equipment

1. See procedure for tub bath.
2. Amount of water should be sufficient to cover patient's hips.
3. Temperature of water (110° F.).
4. Duration of treatment, 20 minutes unless time is specified by doctor.

Precautions

If patient shows signs of dizziness, fainting, or exhaustion, stop treatment, drain water from tub, cover patient with blanket. Report to doctor.

APPLICATION OF DRY COLD

Dry cold is usually applied to the body by means of an ice bag or ice collar.

Purpose: To check inflammation; to relieve pain; to check bleeding.

Ice Bag

Equipment

Ice bag and cover.
Cracked ice (size of walnut).

Procedure

1. Test bag for leaks.
2. Fill bag one-fourth full of ice.
3. Place on flat surface; press from bottom of bag until ice appears in neck of bag. Close tightly.
4. Wipe dry; test for leaks; place inside cover.
5. Apply bag to prescribed area with neck of bag away from patient's body.

Precautions

1. Always cover bag.
2. Change cover when it becomes moist.
3. Refill as necessary to keep cold.
4. Observe patient's skin frequently for signs of mottling, numbness, pallor, complaint of burning sensation.

Ice Collar

Follow same procedure. Use crushed ice. Cover collar by wrapping it with gauze bandage.

APPLICATIONS OF MOIST COLD

Moist cold may be applied to the body by means of compresses and baths.

Purpose: To prevent or reduce swelling; to relieve pain; to reduce temperature.

Cold Moist Compresses (Clean)

Method I—Equipment

Tray.
Basin of ice water.
Compresses of sufficient size to cover area—may be of gauze or flannel or a wash cloth.
Curved basin.
Rubber sheet and cover.

Procedure

Wash your hands!

1. Place covered rubber sheet under part to be treated.
2. Place compresses in ice water.
3. Wring out excess solution; place compresses on part.

Figure 271.—Clean, Cold, Moist Compresses, Method I.

4. Repeat step 3 every 1 or 2 minutes for 20 minutes or for prescribed period of time.

Precautions

1. Watch skin carefully for signs of blanching, mottling.

2. Wring compresses dry as possible before placing on patient.

Method II—Equipment

Tray.
Wash basin.
Gauze 18 x 18.
Block of ice.
Compresses.
Curved basin.
Rubber sheet and cover.

Figure 272.—Clean, Cold, Moist Compresses, Method II.

Procedure

1. Secure gauze over top of basin.
2. Wash off ice: place on gauze.
3. Moisten compresses with clear water, place on ice.
4. Proceed as in steps 3 and 4, method I.

Cold Moist Compresses (Sterile)

Equipment

Tray.
Face basin with cracked ice.
Sterile solution basin, solution.
Two sterile forceps.
Sterile compresses (gauze).
Curved basin.
Rubber sheet and cover.

Figure 273.—Sterile, Cold, Moist Compresses.

Procedure

Wash your hands!

1. Place rubber sheet under part to be treated.
2. With sterile forceps, place sterile compresses in solution basin; then place basin in cracked ice.
3. With sterile forceps, pick up compress; wring out excess solution; apply to part.
4. Repeat step 3 every 1 to 2 minutes for 20 minutes.

Bath—Tepid Sponge

Purpose: To reduce fever.

Indicated: When ordered by doctor or for patients with fever of 103° F. or over.

Figure 274.—Equipment for Tepid Sponge.

Equipment

1. Bath basin one-half full of cool water (95° to 100° F.).
2. Seven wash cloths or seven pieces of gauze.
3. Bath towel.
4. Hand towel.
5. Rubbing alcohol (50 percent).
6. Rubber and cotton draw sheet.
7. Hot water bottle and cover.
8. Ice cap and cover.

Procedure

Wash your hands!

1. Preparation of patient and his unit is the same as for cleansing bed bath and:

Place rubber and cotton draw sheets under patient.

Place ice cap to head, hot water bottle to feet.

2. Order of sponging patient.

Wring out wash cloths in cool water; place one in each axilla, groin, and under each knee. Replace wash cloths frequently.

Follow same order in sponging patient as for cleansing bed bath. Omit genitalia and soaking feet. Pat body dry; avoid vigorous rubbing. Apply alcohol to arms and back.

Watch patient for signs of chilliness, cyanosis; increased pulse rate.

Continue treatment for 20 minutes—unless patient shows reaction. In case of reaction, stop sponge; apply blankets and report reaction to ward nurse or doctor.

Remake bed; leave patient comfortable.

Remove, clean, and store equipment.

Take TPR one-half hour after treatment is completed.

If alcohol sponge is desired, use bathing solution—1 part water to 1 part alcohol. Proceed as above.

PROCEDURES RELATING TO THE GASTROINTESTINAL TRACT

Review, Chapter II, "The Digestive System"

The treatments relating to the gastrointestinal tract are prescribed either to cleanse the area, to apply heat, to administer or remove fluids, or to administer medication. Most of these treatments require clean equipment and solutions except in the presence of gastric surgery when sterile equipment is needed. All equipment used in these treatments must be sterilized after each use and the returns from these treatments should be discarded down the hopper or bedpan flusher.

Mouth care: See "Oral hygiene."

Intubation

The introduction of tubes through the nose or mouth into the stomach is usually the responsibility of the doctor. However, there are times when a corpsman may be called upon to insert a stomach tube or to teach his patient how to do so.

Purposes: To obtain a specimen of gastric contents for laboratory examination; to prepare the patient for a gastric lavage, gavage or suction siphonage.

Types of gastric and intestinal tubes:

Levin tube.—This is a flexible, soft-walled, 16 French, 4-foot tube. It has multiple holes near the rounded tip. Markings on the tube indicate distances of 50, 60, 70, and 80 centimeters. The Levin tube is used for gastric and intestinal drainage, gastric lavage and gavage. It may be inserted either nasally or orally. It is flexible enough so that there is little danger of producing injury. The chief danger is that the tube may readily enter the trachea (fig. 275).

Stomach tube.—This is a stiff, heavy-walled, 28 French, 5-foot tube with a round tip and a funnel at the other end. The stomach tube is used for gastric lavage. It is stiff enough to be easily passed

into the stomach of an unconscious or uncooperative patient. The chief danger is that the tube, due to its stiffness, may damage the larynx or perforate the stomach or esophagus if not carefully used (fig. 276).

Cantor tube.—This is a single lumen, No. 18 French, 10-foot intestinal tube with a small mercury-filled bag at its tip. It is used for intestinal drainage and to relieve intestinal obstruction. The tube is inserted nasally, suction is started when the letter "S" on the tube is at the patient's nose (fig. 277).

Figure 275.—Levin Tube.

Figure 276.—Stomach Tube.

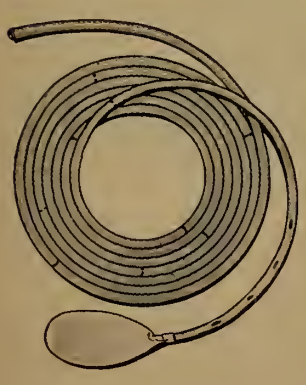

Figure 277.—Cantor Tube.

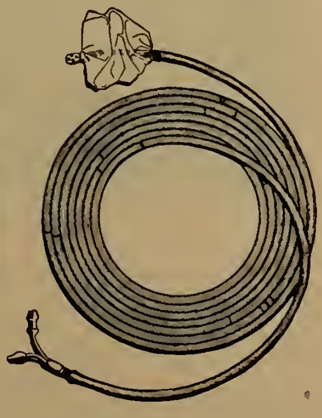

Figure 278.—Miller Abbott Tube.

Miller-Abbott tube.—This is a metal tipped, double lumen, No. 16 French, 10-foot intestinal tube with a small balloon near its tip. One lumen of the tube is used to inflate the balloon; the other, entirely independent, for aspiration. Markings on the tube indicate the distance it has been passed. The tube is inserted nasally and suction is started when the first mark is at the patient's nose. Peristaltic action carries the balloon and tube along the intestine (fig. 278).

Intubation Technique (Nasal)

Equipment

Levin tube in basin of ice water.
Water soluble lubricant.
20 to 30 cc. syringe.
Bath towel.
Rubber sheet.
Paper mouth wipes.
Curved basin.

Procedure

1. Place patient in Fowler's or sitting position. Explain procedure to him.
2. Secure bath towel around his neck. Place rubber sheet over bedding.
3. Remove tube from ice water. Lubricate tip very lightly.
4. Ask patient to tilt head slightly backward.
5. Hold tube about 6 inches from its tip. Rotate it until position of greatest "droop" is found.
6. Holding tube in this position, pass it through the nostril into the pharynx. Ask the patient to swallow. Each time he swallows insert the tube a few inches. Do not use force. Continue inserting the tube until second marker on tube is reached.

Caution.—Should patient start coughing, choking or become cyanotic; remove tube quickly. Allow patient to rest a few minutes. Re-insert tube.

7. Attach syringe to tube and aspirate gastric contents.
8. To remove tube:

Place towel close to patient's chin.
Pinch tube at patient's lips.
Gently but quickly remove tube and place it directly into towel.
Intubation technic oral—see Gastric Lavage.

Suction Siphonage (Wangensteen)

Purpose: To provide constant drainage of the gastrointestinal tract.

Indicated: When ordered by doctor:

To relieve or prevent abdominal distention; to remove gas or fluids from gastrointestinal

tract, to relieve intestinal obstruction; to relieve postoperative nausea and vomiting.

Types of suction apparatus

1. *Three bottle method.*—A partial vacuum is created in the drainage bottle by the flow of water from the top bottle to the bottom bottle.

2. *Hand pump method.*—A partial vacuum is created in the drainage bottle by pumping some air out of the tank.

Both types.—Since the pressure in the drainage bottle is lower than the pressure in the stomach, the stomach contents are siphoned into the drainage bottle.

Three Bottle Method

Equipment: From CDR

Siphonage unit.
Levin tube.
Glass connecting tip.

On ward

Lubricant for tube.
Basin of cracked ice.
Curved basin.
Rubber sheet and cover.
Adhesive strips (½″ wide x 6″ long—split halfway down the middle).
Safety pin.
Elastic band.
Large paper bag to cover drainage bottle.

Procedure

Preparation of equipment

1. Place Levin tube on ice.
2. Attach connecting tip to tubing of drainage bottle. Close clamp on tubing.
3. Invert center bottles, water will start flowing from top to bottom bottle.
4. Open clamp, test for suction by placing finger over opening. Close clamp.
5. Take all equipment to bedside.

Preparation of patient

1. Screen and tell patient what is to be done. Levin tube is introduced. See "Intubation Technique" (p. 233).
2. Attach Levin tube to connecting tip of drainage bottle. Open clamp.
3. Tape Levin tube to patient's forehead or cheek.

Figure 279.—Wangensteen Apparatus.

4. Loop elastic band about tubing near connecting tip, pin to bedding.
5. Place drainage bottle in paper bag.

During treatment

1. Invert center bottles whenever top one is empty.
2. Empty drainage bottle when it becomes two-thirds full or every 12 to 24 hours.

To empty drainage bottle:

Close clamps on tubing to center bottles and Levin tube.
Unscrew cap, remove bottle.
Measure and note contents.

Rinse bottle with cold water, wash with soap and water.

Replace bottle, screw on cap, open clamps.

3. Watch working order of apparatus; report any signs that siphonage is not working.
4. Keep accurate intake and output records.
5. Give mouth care every 4 hours. (Patient may have chewing gum if ordered.)
6. Apply ointment or oil to each nostril every 4 hours.
7. Do not clamp tubing or stop siphonage unless ordered by doctor.
8. Give only clear fluids by mouth if ordered (water, tea, black coffee, broth, strained soups. No milk, solids).
9. Irrigate tube as ordered.
10. Observe patient. Report any complaints of nose and throat irritation; any signs of blood in drainage.

Charting nursing notes

Time of starting treatment.

Patient's reaction to treatment.

Describe drainage—amount, color, odor, each time bottle is emptied.

Care of equipment

1. Wash tubing, drainage bottle, and cap. Boil 5 minutes. Replace on apparatus.
2. Wash Levin tube, boil 5 minutes.
3. Return borrowed equipment to CDR.
4. Wash metalware, boil 10 minutes.
5. Return equipment to proper places.

Precautions.—*Do not disturb center bottles of apparatus.*

Hand Pump Method

Equipment: From CDR

Hand pump apparatus.

Gallon bottle.

Two-hole rubber stopper.

Two pieces 4-foot tubing.

Connecting tip.

From ward

Same as for 3-bottle method.

To connect apparatus

1. Connect the two pieces of tubing to the rubber stopper.
2. Insert the rubber stopper into the gallon bottle. Be sure the stopper fits tightly.

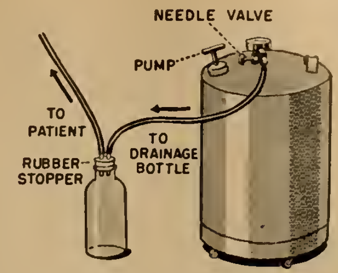

Figure 280.—Hand Pump Apparatus.

3. Connect the free end of one piece of tubing to the gage on the tank.
4. Connect the other piece of tubing to the patient's tube.

To start siphonage

1. Open needle valve on tank by turning knurled knob in a counter clockwise direction.
2. Create suction in tank by pumping approximately 40 to 50 strokes until the gage registers 5.

If the nasal tube is free from leaks; if the rubber stopper in the drainage bottle is free from leaks; if the tubing connecting the drainage bottle to the tank is free from leaks, this suction should be sufficient to last the average patient about 20 hours.

The care of the patient during treatment is similar to the 3-bottle method. Watch gage; dial should read 3 to 5 during treatment.

Improvised (Wangensteen) Three-Bottle Method

Equipment

Three gallon bottles.

Three lengths rubber tubing—one (6 feet); one (4 feet); one (3 feet).

Two 2-hole rubber stoppers to fit bottles.

Two clamps for tubing.

Four lengths glass tubing—one (1 foot); two (3 inches); one (6 inches).

Bandage or tape for hanging bottle.

One Levin tube.

One connecting tip.

One standard or other apparatus for hanging bottle.

Preparing the equipment

In utility room

1. Mark bottles for measuring fluids (see simple drainage).

2. Insert 1 long and 1 short glass tubing in each rubber stopper.

3. Insert stoppers into 2 bottles.

4. Set up suction.

In utility room

Bottle No. 1.—Fix bandage, or tape to hang on hook. Fill to 4,000 cc. with water. Insert stopper with 1-foot glass tubing into bottle. Attach 6-foot-length rubber tubing to short glass tube.

Bottle No. 2.—Fill with water to 300 cc. Place rubber tubing from bottle No. 1 so that end is under water.

Bottle No. 3.—Insert rubber stopper. Attach 4-foot tubing to long tube of bottle No. 1, attach 3-foot tubing to other glass tube.

Apply clamps.—One to tubing from bottle No. 1 to No. 3, one to tubing from bottle No. 3 to Levin tube.

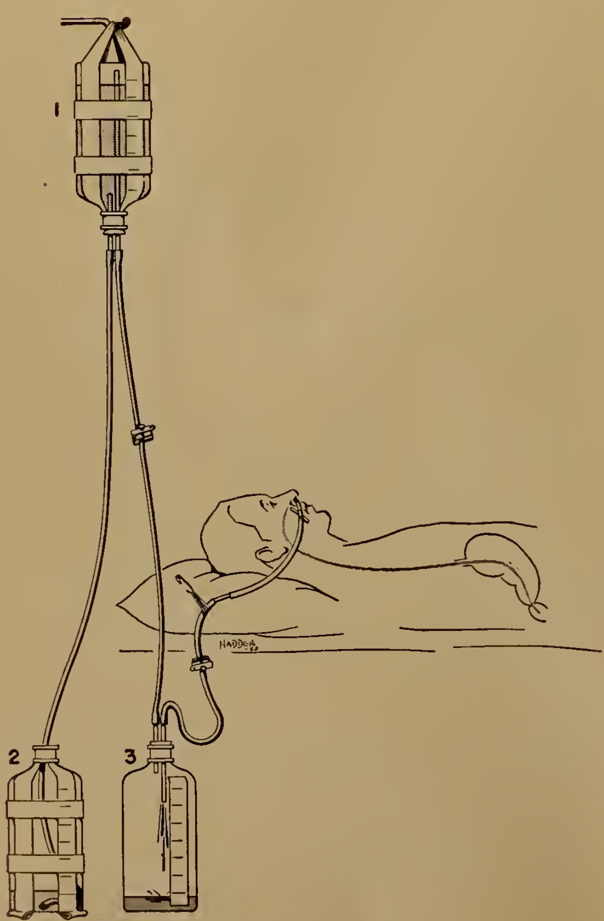

Figure 281.—Improvised Apparatus.

At bedside

1. Place bottles No. 2 and No. 3 on deck.
2. Be sure all clamps are closed.
3. Invert and hang bottle No. 1 on standard 2½ feet above bed level.

Starting siphonage

1. Levin tube is introduced. (See "Intubation Technique.")
2. Connect Levin tube to tube of drainage bottle No. 3.
3. Release clamp on tubing from bottles No. 1 to No. 2.
4. Release clamp on tubing of drainage bottle No. 3. Care of patient is same as for three-bottle method.

Tube Irrigations

Indicated: When ordered by the doctor.

Equipment [19]

1. Basin.
2. Bulb syringe or 30 cc. Luer syringe.
3. Curved basin.
4. Small covered rubber sheet.

Solution [19]

100° F.–250 to 500 cc.
Water.
Normal saline.

Procedure

1. Clamp tubing to drainage bottle.
2. Place covered rubber sheet on bed under connector of Levin tube and drainage tube.
3. Place curved basin under connector.
4. Disconnect tubing.
5. Fill syringe, insert tip into Levin tube, gently inject solution.
6. Allow solution to drain out of tube into curved basin.
7. Repeat steps 5 and 6 until all solution is used.
8. Connect Levin tube to drainage tube, unclamp tube.
9. Remove equipment, measure returned fluid.

Charting

Record amount of fluid used, amount returned.

Note: A glass Y tube may be used in place of the connecting tip. Step 4 may then be omitted.

[19] Solution and equipment must be sterile when used for a patient who has had gastric surgery.

Gastric Lavage

Purpose: To empty stomach.

Indicated: When ordered by the doctor: As a preoperative preparation for gastric surgery; to remove poisons.

Equipment

Tray containing:

Stomach tube in basin of ice water.

Two-gallon pitcher of warm water (105° F.), or solution ordered by doctor.

Large pail for returns.

Rubber sheet and cover.

Curved basin, paper wipes.

Procedure

Preparation of patient and his unit

1. Screen and tell patient what you are going to do.
2. Place patient in Fowler's position.
3. Place covered rubber sheet over bedding and under patient's chin.
4. Give patient curved basin and paper wipes to hold.
5. Place pail on deck or bench.
6. Locate white marker on stomach tube.

Method

1. Place tube far back in mouth; ask patient to swallow; each time patient swallows insert tube few inches until marker is reached. If patient starts coughing, choking, becomes cyanotic—remove tube quickly. Allow patient to rest a few minutes. Then re-insert tube.
2. Invert funnel, allow drainage.
3. Hold funnel upright, pour solution into funnel and keep full until approximately 500 cc. has been given.
4. Invert funnel while there is still some solution in it, allow to drain.
5. Repeat steps 3 and 4 until returns are clear or until amount ordered has been used. If patient becomes exhausted, stop lavage, report to doctor.
6. Pinch tube at patient's lips, withdraw quickly into curved basin.
7. Make patient comfortable, remove equipment, leave unit in order.

Care of equipment

1. Measure returns.
2. Place linen in hamper.
3. Wash, boil tube 5 minutes.
4. Wash pail with soap and water, rubbing vigorously for 2 minutes.
5. Wash and boil basin and pitcher 10 minutes.

Charting: Nursing notes

1. Time—Gastric Lavage—amount of solution used.
2. Amount, appearance, and odor of returns.
3. Signature.

If Levin tube is used. Add 50 cc. syringe to equipment. Tube may be inserted through nose. Plunger of syringe may be used to start or re-establish drainage.

Gastric Gavage

Purpose: To introduce liquid food or medication into the stomach by means of a tube.

Indicated: When ordered by the doctor for patients: Who are unable to swallow; who are unconscious; who refuse to eat; who have spasm or stricture of the esophagus.

Equipment: To equipment for intubation technique add: Fluid to be fed.

Procedure

1. Warm liquid food to body temperature.
2. Follow procedure for intubation technique, steps 1 through 6.
3. Attach barrel of syringe to tube.
4. Slowly pour fluid down side of syringe. Keep syringe full of fluid until all has been given.
5. Pour 60 cc. of water into tube after fluid to clear tube.
6. To remove tube. Follow step 8 of intubation technique procedure.

Charting nursing notes: Time; amount and name of fluid; state whether tube was introduced orally or nasally.

Evacuative Enema

Purpose: To remove feces from lower intestinal tract; to relieve flatulence and abdominal distention.

Cleansing enema—To remove feces:

1. Soap suds solution (S. S. E.) (White soap) 500–1,000 cc.
2. Normal saline solution (N. S.) (1 teaspoon salt to 1 pint of water) 500–1,000 cc.
3. Plain water.

Carminative enema.—To relieve flatulence and abdominal distention:

1. 1–2–3 enema. 1 ounce magnesium sulphate. 2 ounces glycerin. 3 ounces water.
2. Milk and molasses—6 to 8 ounces of each.
3. Sodium bicarbonate—8 grams (2 teaspoonfuls) to 500 cc. hot water.

Temperature of solution: 105° to 110° F.

Cleansing Enema

Tray Containig—

Irrigating can.
Rubber tubing.
Clamp.
Glass connecting tip.
Rectal tube No. 24 French.
Lubricant (water soluble).
Curved basin.
Toilet tissue.

Figure 282.—Equipment for Cleansing Enema.

Tongue blade.
Rubber sheet with cover.
Pitcher. Covered bedpan and urinal.

Procedure

Preparation of patient and unit

1. Screen patient, explain procedure to him.
2. Clear the top of bedside locker.
3. Lower backrest and turn patient on left side or side most comfortable for him (Sims position). For patients who are paralyzed or unable to retain any fluids, place the patient on a bedpan before injecting fluid.

Preparation of equipment

1. Attach rectal tube to glass connecting tip; clamp tubing.
2. Fill pitcher with solution (110° for cleansing; 105° for carminative).
3. Pour solution into irrigating can, allow solution to run through tubing, clamp.
4. Remove small amount of lubricant from jar with tongue blade and place on piece of toilet tissue.
5. Lubricate rectal tube, leave tissue around tube.
6. Cover bedpan, place tray on top of pan and carry to bedside. Carry urinal by handle.

Method

1. Place bedpan and urinal on chair, tray on bedside table.
2. Fold back upper bedding in triangle to expose anus.
3. Place covered rubber sheet under patient's buttocks.
4. Place curved basin next to anus.
5. Open clamp on tubing, allow small amount of solution to run through tube into curved basin.
6. Raise upper buttock, locate anus, insert rectal tube 3 to 4 inches, hold in place with left hand.
7. Open clamp with right hand, hold irrigating can approximately 18 inches above anus.
8. Allow solution to flow slowly.
9. If patient complains of discomfort or "cramps," pinch tubing for a few moments.
10. Continue flow until patient has taken all solution or as much as he is able.
11. Clamp tubing, place can on tray, disconnect rectal tube over curved basin.

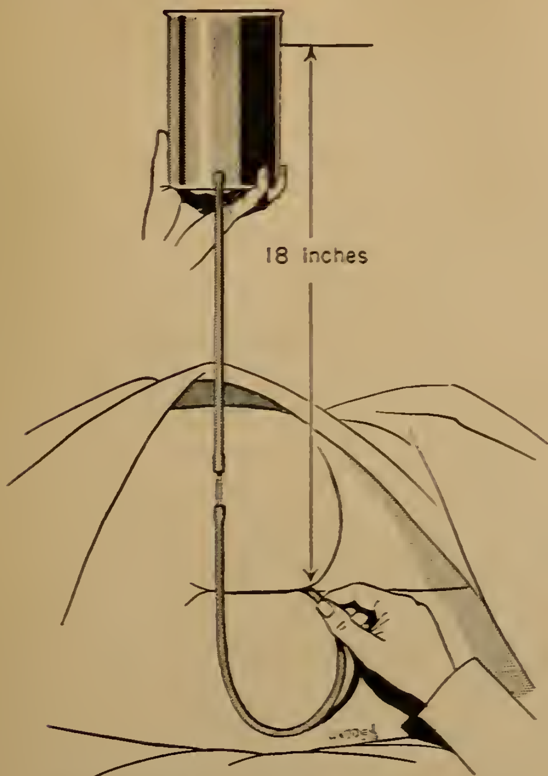

Figure 283.—Administration of Cleansing Enema.

12. Pinch and withdraw rectal tube, place in curved basin, remove basin.
13. Place patient on bedpan;[20] elevate backrest.
14. Place toilet tissue and call bell within his reach.
15. Carry tray to utility room. Wash your hands.
16. Leave patient alone until he calls, but look in on him frequently.
17. When patient is finished, remove and cover bedpan; assist patient with cleansing if necessary.[21]
18. Take bedpan to utility room, inspect contents; note amount, odor, color and consistency, unusual appearance.
19. Take basin of water to patient to wash his hands.

Care of equipment

1. Rinse irrigating can and tubing with warm water.
2. Run cold water through rectal tube, wash with soap and water; rinse. (Use applicators if necessary to clean "eye" of tube.)
3. Boil irrigating can, curved basin, tubing, and rectal tube.
4. After boiling, immerse rubber goods in cold water, dry, hang up to drain.
5. Scour metalware.
6. Sponge off rubber sheet.
7. Reset tray.

Charting: Nursing notes

1. Time.
2. Type of enema given.
3. Results.
4. Reaction of patient.
5. Signature.

Retention Enema

Purpose: To produce a general systemic effect, such as a sedative; to give local remedial effect, to soften feces, to relieve irritation.

Types

1. *Oil enema.*—4–5 ounces of warm oil (mineral, olive, cottonseed).
2. *Sedative.*—Dosage mixed with 2 to 3 ounces of water, oil, or corn starch solution.

Example:

Chloral hydrate	Dosage as ordered by doctor.
Paraldehyde	
Sodium bromide	

Figure 284.—Equipment for Retention Enema.

[20] Carminative enema—urge patient to retain solution for 20 minutes if he is able. When small amount of solution is ordered (4–6 oz.) use retention enema equipment.

[21] If patient is unable to expel enema, insert rectal tube and siphon fluid into bedpan.

3. *Cornstarch.*—4 to 6 ounces water; dissolve enough starch to make smooth, white fluid. Temperature of solution 100° F.

Equipment

Tray.
Pitcher.
Funnel.
Rectal tube French 20 or catheter.
Lubricant.
Tongue blade.
Toilet tissue.
Covered rubber sheet.

Procedure

Preparation of patient and unit

1. Screen patient, tell him what you are going to do.
2. Clear top of bedside locker.
3. Turn patient on either side (most comfortable position for him).
4. Place covered rubber sheet under patient's buttock.

Preparation of equipment

1. Prepare solution ordered at correct temperature.
2. Put lubricant on toilet tissue and lubricate rectal tube.
3. Attach rectal tube to funnel. Place in curved basin.
4. Take tray to bedside.

Method

1. Expose anal area by forming triangle of upper bedding. Place curved basin next to anus.
2. Fill funnel with solution, allow solution to flow through tube back into pitcher, pinch tubing before funnel is empty.
3. Holding funnel in one hand, raise upper buttock and insert rectal tube about 4 inches.
4. Raise funnel even with top of buttock. Allow solution to flow slowly,[22] keep funnel full until all solution has been given.
5. Pinch tube—remove and place in curved basin—disconnect funnel and tube. Place basin on tray.

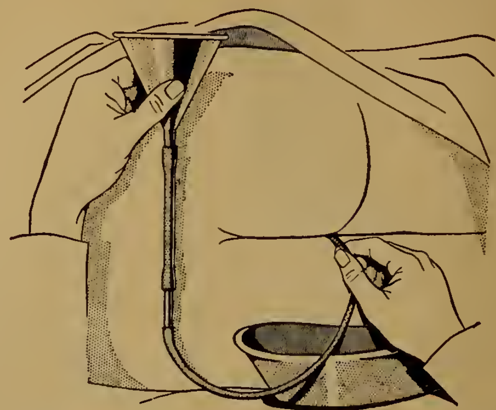

Figure 285.—Administration for Retention Enema.

6. Leave patient on his side, do not disturb him.
7. Take equipment to utility room.

Care of equipment: Same as for evacuative enema.

Charting: Nursing notes

1. Time.
2. Type and amount of solution.
3. Whether or not solution was retained.
4. Signature.

Colostomy Irrigation

Purpose: To remove feces from the large intestine.

Equipment: Same as for cleansing enema except:

1. Use smaller tube, 18–22 French catheter or rectal tube.
2. 500 to 750 cc. normal saline or water at 100° F.
3. Add dressing tray and curved basin.

Preparation and after care of equipment.—Same as for a cleansing enema.

Procedure

1. Screen patient, tell him what you are going to do.
2. Turn the patient on the side of the colostomy.
3. Place a covered rubber sheet on the bed under the colostomy.
4. Remove the dressing; place it in the curved basin.
5. Place the second curved basin under the colostomy opening.

[22] Solution must be given very slowly to avoid stimulating bowel movement. If patient has difficulty retaining solution, apply gentle pressure with toilet tissue to rectum until desire to defecate has passed.

6. Introduce lubricated catheter about 4 inches into the colostomy, hold the tube in place with the left hand.

7. Raise irrigating can 10 inches above the colostomy.

8. Allow solution to flow slowly until all has been given, then pinch and remove the tube.

9. Leave curved basin in place until return flow stops.

10. Open dressing tray, clean wound with soap solution, apply dressing.

11. Make patient comfortable; leave unit clean and in order.

NOTE.—Be gentle and tactful with this patient, particularly if the colostomy is a recent one. He has to become accustomed to this new situation in which he has no control of his bowel movements and he has fears of possibly offending and embarrassing himself and others. Reassure and encourage him. The colostomy can be regulated in almost the same way as the rectum but it takes time, patience, attention to diet, and the complete cooperation of the patient and all personnel.

PROCEDURES RELATING TO THE GENITOURINARY TRACT

Review—Chapter II, "The Excretory System"

"The Reproductive System"

Chapter VII, "Drugs Which Act On the Urinary System"

The treatments relating to the genitourinary tract are prescribed in order to cleanse the area, apply heat, to administer medications or to remove fluid. All treatments requiring the insertion of any instrument into the urinary bladder must be executed using sterile technique. The corpsman is urged to obtain supervision when doing these treatments because of the danger of infection due to faulty aseptic technique or the danger of producing injury due to improper insertion of catheters.

The treatments discussed in this section are limited to those a corpsman would be likely to be called upon to do in a ward or sick bay. Other special genitourinary treatments are given in the G. U. clinic by the doctor or a trained technician.

Catheterization

Purpose: To remove urine from the bladder by means of a catheter introduced through the urethra.

Indicated: When ordered by the doctor: To relieve retention of urine; before certain operations; to collect a sterile specimen of urine.

Equipment

Sterile

One pair rubber gloves.
Two solution cups.
Two catheters Nos. 14, 16, 18 French.
One curved basin.
Six gauze sponges or cotton balls.
Two 4 x 4 gauze flats.
One sterile towel.
One forceps or hemostat.
One specimen bottle.

Unsterile

One small rubber sheet and cover.
One curved basin.
One urinal.

Procedure

In utility room

1. Wash your hands!
2. Open sterile tray.
3. Fill solution cups.
4. Place small amount of lubricating jelly on a 4 x 4 gauze flat.
5. Cover tray, take to bedside with the rest of the equipment.

At bedside. **Male patient.**

1. Screen patient and tell him what you are going to do. Ask him to place his hands under his head and keep them there. Position—dorsal recumbent.
2. Fan-fold top bedding to patient's knees. Cover his chest with an extra sheet if ward is cool.
3. Place covered rubber sheet over thighs and under penis.
4. Place unsterile basin on covered rubber sheet.

5. Place tray on bedside locker. Open tray.

6. Hold penis just back of head of penis, retract foreskin if possible.

7. Scrub the head of the penis with three soap solution cotton balls and discard cotton balls into unsterile basin.

8. With forceps, remove soap with three boric acid solution cotton balls.

9. Remove unsterile basin. Open sterile towel, place on rubber sheet, place cleansed penis on sterile towel.

10. Put on sterile rubber gloves.

11. Place sterile curved basin on towel.

12. Pick up catheter, lubricate tip with jelly, hold other end between third and fourth finger.

13. Hold penis at 60° angle, with other hand.

Figure 286.—Insertion of Catheter.

14. *Insert catheter until resistance is felt, apply steady gentle pressure*, lower penis and continue insertion until urine begins to flow, place end of catheter in sterile basin.

15. If specimen is to be obtained, collect 120 cc. in specimen bottle.

16. When urine ceases to flow, pinch catheter and remove it quickly and gently.

17. Leave patient dry, covered, and comfortable.

18. Remove equipment. Measure amount, note color, appearance and odor of urine.

19. Cover sterile specimen with sterile 4 x 4's held in place by elastic band.

20. Clean, sterilize, and store equipment.

At bedside. **Female patient.** Same purpose, equipment and preparation of equipment, add 1 sheet and drop light.

1. Screen patient, tell her what you are going to do.

2. Drape sheet diagonally over patient. Fan-fold bedding to foot of bed.

3. Draping: Fold back corner (2) to groin. Wrap corners (3) and (4) around patient's right and left feet, leaving the genital area exposed.

Figure 287.—Draping the Patient.

4. Place a covered rubber sheet under patient's buttocks.

5. Place tray on bed between patient's legs, unsterile basin to one side of tray, place droplight to give best light.

6. Open tray, fold back tray cover to patient's buttocks.

7. Put on sterile gloves.

8. Separate labia, with left hand. Pick up forceps in right hand.

9. Cleanse labia, urinary meatus, perineum with cotton balls of soap solution. Follow with boric

Figure 288.—Female Genitalia.

acid solution. Use each cotton ball once, always wiping from labia to perineum and off. Discard cotton into unsterile basin.

10. Place sterile basin close to buttocks.
11. Pick up catheter, lubricate tip, hold other end of catheter between third and fourth fingers.
12. With other hand separate labia, locate meatus.
13. Insert catheter gently until urine begins to flow (1½ to 2 inches). Place end of catheter in basin.
14. If specimen is to be obtained, collect about 120 cc. directly into specimen bottle.
15. Pinch and remove catheter when urine flow stops.
16. Leave patient dry, covered, and comfortable.
17. Clean, sterilize, and store equipment.

Charting—Nursing notes

1. Time.
2. Treatment.
3. Amount, color, appearance, and odor of urine obtained.
4. Complaints of patient.
5. State if specimen was obtained.
6. Signature.

Indwelling or Retention Catheter

The doctor inserts a retention catheter. The corpsman is responsible for the preparation of the patient and equipment and for keeping a record of intake and output.

Purpose: To provide constant drainage of urinary bladder.

Indicated: When ordered by doctor for patient—following surgery, when patient is incontinent of urine, or is having difficulty in voiding.

Types of Catheters Used

Mushroom.—Has small bulb near tip. The catheter is stretched over a metal director and inserted. When director is removed, small bulb reforms in bladder, holding catheter in place.

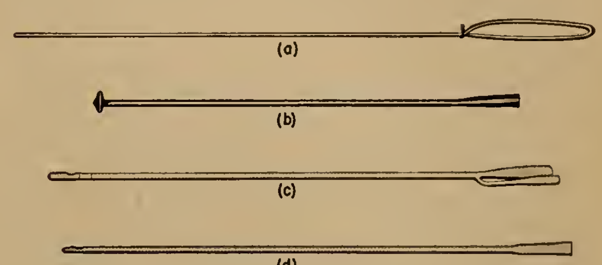

Figure 289.—A—Catheter Director; B—Mushroom Catheter; C—Foley Catheter; D—French Catheter.

Foley.—Double lumen catheter; one opening is for drainage, other opening is to small balloon at tip of catheter which is inflated with 4 cc. sterile water after it is inserted into bladder. Screw clamp is then applied to this opening and is not released until catheter is to be removed.

French.—This is a straight catheter. It is fastened by placing adhesive tape along one side of the shaft of the penis, wrapped about the catheter, and fastened on the other side of the penis. Two strips of adhesive are then placed around the shaft of the penis in the manner illustrated (fig. 290).

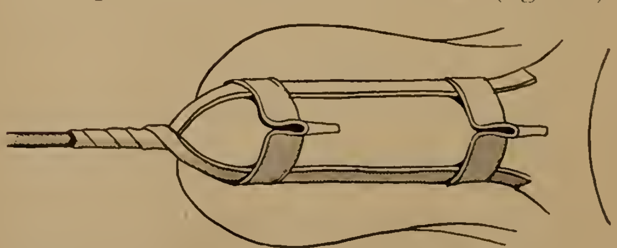

Figure 290.—Retention Catheter in Place.

Equipment

All equipment for catheterization, plus:

1. For Foley catheter.
   Sterile catheter.
   Sterile solution basin.
   Sterile water.
   Sterile 10 cc. syringe.
   Screw clamp.
2. For Mushroom catheter.
   Sterile catheter.
   Sterile metal director.
3. Sterile drainage tubing and connecting tip.
4. Gallon drainage bottle.
5. Rubber band and safety pin.
6. Adhesive tape.
7. Bandage.

Procedure

1. Follow procedure for catheterization.
2. Connect catheter to drainage. See "Simple drainage."

Bladder Irrigation

Purpose: To wash out the urinary bladder.

Indicated: When ordered by the doctor to cleanse the area of sediment, bacteria and their products, pus and excess mucus; to relieve inflammation; to control bleeding.

Method I.—Following catheterization

Equipment

1. Same as for catheterization, plus:
   Sterile Pitcher,
   bulb syringe or glass funnel,
   solution—may be boric acid 4 percent.

Temperature of solution 100° F.

Amount—as ordered by doctor, 250 to 500 cc.

Procedure

1. Follow catherization procedure; do not remove catheter.
2. Attach glass portion of asepto syringe or glass funnel to catheter.
3. Place curved basin under funnel, pour solution slowly along side of the syringe or funnel.
4. Invert syringe or funnel and allow solution to drain into curved basin.
5. Repeat steps 3 and 4 until all solution has been used.
6. Follow catheterization procedure for removing catheter, care of patient and equipment.

Method II.—Intermittent irrigation—indwelling catheter in place.

1. Add small covered rubber sheet to equipment.
2. Place covered rubber sheet under connecting tip of catheter and drainage tubing.
3. Place curved basin on rubber sheet.
4. Disconnect tubing and catheter.
5. Attach glass portion of syringe or funnel to catheter.
6. Do steps 3, 4 and 5 of method I.
7. Connect tubing and catheter.
8. Remove equipment, straighten bedding, leave patient comfortable.
9. Measure and chart returns—its color, is there mucus or pus? Is it cloudy or bloody? What was the effect on the patient?
10. Place linen in hamper. Wash, boil and store equipment.

Method III.—Continuous irrigation

Equipment—sterile

1,000 cc. solution in sterile bottle.

Rubber tubing, one 4-foot length, one 2-foot length, and one 1½-foot length.

Connecting tips, one Y tube, one straight tube.

Gallon bottle.

Two-hole rubber stopper with two short pieces of glass tubing.

Murphy drip regulator.

Equipment—unsterile

Standard.

Elastic band and safety pin.

Two screw clamps.

Procedure—Preparation of equipment

1. Insert two hole stopper into gallon bottle.
2. Place one clamp on 1½-foot tubing. Close clamp.
3. Connect 4-foot tubing to bottle and 1 prong of Y tube. Insert drip regulator just below bottle.
4. Connect 2-foot rubber tubing to drainage bottle and other prong of Y tube.

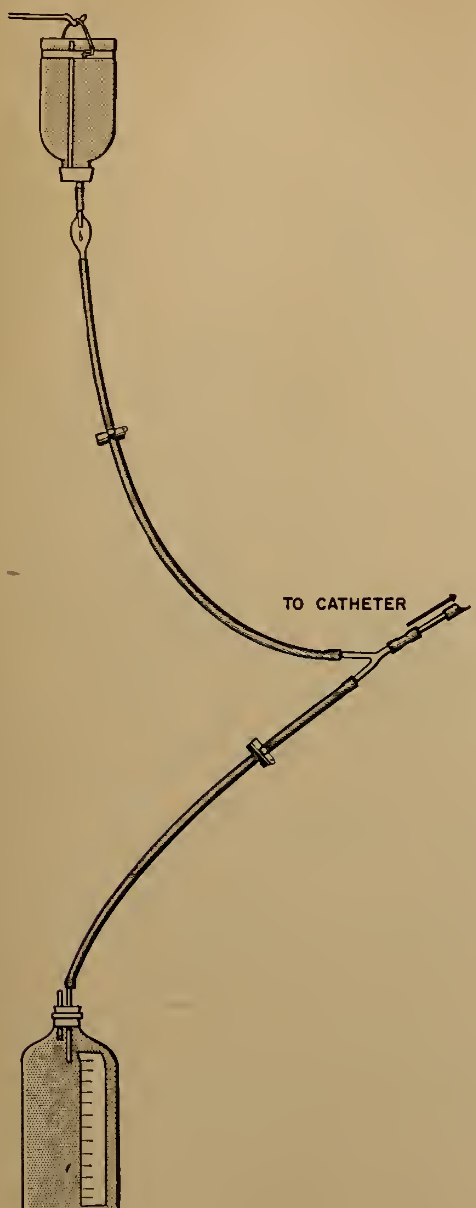

Figure 291.—Bladder Irrigation.

5. Connect $1\frac{1}{2}$-foot tubing to straight of Y tube.

6. Hang bottle on standard. Release clamp on 4-foot tube. Allow solution to run through tubing until all air is removed. Close clamp.

Method

1. Explain procedure to the patient.

2. Attach $1\frac{1}{2}$-foot tubing to patient's catheter with straight connecting tip. Open clamp, allow urine to flow into drainage bottle.

3. Loop elastic band around Y tube and pin to patient's drawsheet.

4. To irrigate the bladder:

Pinch off outflow tube by hand.

Release clamp on inflow tube, allow 50 cc. of solution to flow into bladder. Close clamp. Release outflow tube.

5. Step 4 is repeated as ordered by the doctor. With the doctor's permission, the patient may be taught to do step 4 himself.

Charting nursing notes

Time treatment started.

Amount, name, strength, and temperature of solution used.

Description of the returns.

Patient's reaction to treatment.

Signature.

Precautions

1. All connections must be handled without contamination.

2. Solution bottle must be kept filled.

3. Control the speed of inflow by adjusting the screw clamp on inflow tube.

4. Keep accurate intake and output records.

5. If Kelly flask is used for solution, the top must be kept covered with sterile 4 x 4's.

Bladder Instillation

Purpose: To treat the bladder with an antiseptic solution.

Equipment: Catheterization tray, plus—

Medication in sterile container.

Sterile syringe.

Procedure

1. Follow procedure for catheterization through to removal of urine.

2. Attach syringe to catheter.

3. Pour medication into syringe.

4. When all medication has passed through catheter, pinch and remove catheter.

5. Proceed as in catheterization.

NOTE.—Bladder irrigation and instillation are often ordered for the patient following catheterization.

Simple Drainage

Purpose: To provide for removal of fluids from wound or body cavity.

211866°—53——17

Indicated: When drainage is desired from wound, from urinary bladder, or from other body cavity.

Equipment

Gallon bottle, 2-inch adhesive tape, and ink or colored pencil for marking bottle.
Glass connecting tip.
Rubber tubing, 3-foot length.
Safety pin.
Elastic band.
Two-inch bandage.
Graduate.

Procedure

Preparation of equipment

Provide for measuring fluid (fig. 292).

1. Place adhesive tape on side of bottle.
2. Pour 500 cc. water into bottle. Mark water level with ink or colored pencil.
3. Continue step 2 until 4,000 cc. is reached and marked.
4. Divide each space between marks evenly with four short lines. Bottle is now graded at 100 cc. levels. Empty bottle.

Attach connecting tip to tubing; place other end of tubing in bottle.

Preparation of patient

1. Attach connecting tip to catheter from wound or bladder.
2. Tie drainage bottle to lower bar of bed at side.
3. Loop rubber band around rubber tubing, pin to bedding. Rubber tubing should be long enough to allow patient to move freely in bed.

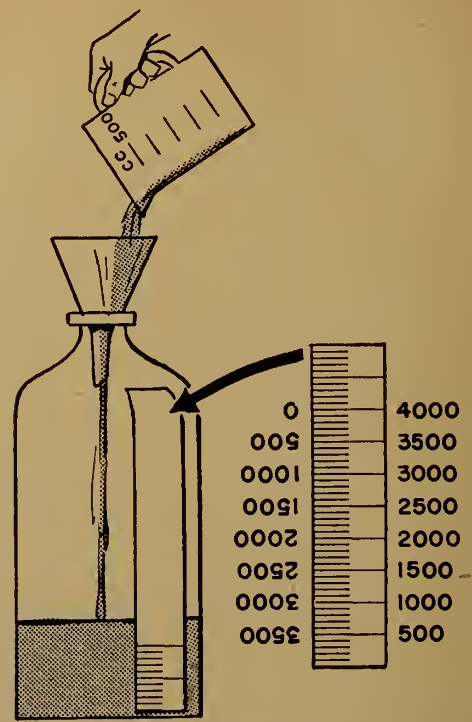

Figure 292.—Marking the Measurement of a Bottle.

During treatment

1. Watch drainage, check amount, color, appearance, and odor.
2. Empty drainage bottle every 24 hours.
   a. Measure and record amount.
   b. Wash bottle with cold water, warm soapy water, rinse and dry.

After treatment

1. Wash and boil equipment.
2. Return equipment to proper place.

PROCEDURES RELATING TO THE EYE, EAR, NOSE, AND THROAT

Review—Chapter II, "The Respiratory System" "Special Senses"

Treatments of the eye, ear, nose, and throat are usually given to administer heat or cold to the area (compresses); wash away discharges (irrigations); or to apply medication (drops).

The treatments of the eye which involve direct application to the eye itself require surgical aseptic (sterile) technique. Other procedures are clean treatments. The corpsman should be very gentle when performing these treatments for his patients. Carelessness of the corpsman may result in blindness, deafness, or severe infection to the patient.

Charting of eye, ear, nose, and throat treatments.—Time treatment was given; amount, name, strength, and temperature of the solution used; name of the part treated; the results of the treatment; if irrigation, describe the returns; the reactions of the patient to the treatment.

EYE TREATMENTS

Instillation of Eye Drops

Purpose: To relieve pain. To prepare for examination. To anesthetize preoperatively.

Equipment

1. Sterile medicine dropper in tube.
2. Fresh medication specially prepared for use in eye.
3. Clean basin containing sterile water, normal saline, or boric acid solution 2 percent at 100° F. to cleanse eyelids of discharges.
4. Clean cotton balls.
5. Curved basin. Paper wipes.

Precautions

1. Use only fresh, sterile medication specially prepared for eye use. Check dates on labels of eye medications.
2. Read medication label three times.
3. Use sterile medicine dropper.
4. Do not use dry cotton on eye.
5. Wash your hands before all treatments.

When no discharge is present, cleansing equipment and step 1 of the procedure may be omitted.

Procedure

1. Moisten cotton ball, cleanse discharge from lids. Wipe from inner to outer side—use new cotton ball for each stroke.
2. Draw medication up into dropper, hold dropper upright so medicine does not enter bulb.
3. With dropper in one hand, take paper wipe in other and gently draw down lower lid by placing first two fingers on cheek.
4. Ask patient to look up.

Figure 293.—Instillation of Eye Drops.

5. Drop prescribed number of drops into pocket formed by lower lid. Hold dropper parallel to eye. Rest your hand on patient's forehead.
6. Have patient gently close eyes; hold wipe at inner corner of eye.

Application of Eye Ointment

Purpose: To treat infection, to dilate or contract pupil, to lubricate the eye.

Precaution: Hold ointment tube parallel to eye.

Procedure

1. Draw down lower lid by placing first two fingers on cheek.
2. Apply ointment along rim of lower lid.
3. Have patient close eyes.
4. Massage only if ordered.

Figure 294.—Application of Ointment to Eye.

Eye Irrigation

Purpose: To remove discharges; provide moist heat; remove foreign body.

Equipment

Sterile

Tray with following:

Solution basin.

Solution 105° F. (may be water, normal saline, boric acid 2 percent) 30 to 90 cc.

30 cc. asepto syringe or medicine dropper.

Clean (for cleansing eye lids)

Cotton balls.

Basin of water.

Curved basin.

Face towel.

Precautions: When both eyes are affected, use separate equipment for each eye, wash hands thoroughly between treatments of eyes.

Procedure

1. Place towel over shoulders.
2. With moistened cotton ball, cleanse discharge from eye.
3. Fill asepto syringe, expel air.
4. Separate eye lids, direct flow from inner to outer canthus. Use only sufficient force to cause continous flow of solution.
5. Continue steps 3 and 4 until all solution is used.
6. Wipe cheek with towel.

Eye Compresses

See applications of heat and cold, pages 227–231.

EAR TREATMENTS

Installation of Ear Drops

Purpose: To soften wax; to relieve pain; to shrink foreign body.

Equipment

1. Clean medicine dropper.
2. Bottle of medication in basin of warm water.
3. Cotton applicators.
4. Paper bag for waste.

Figure 295.—Eye Irrigation.

Figure 296.—Instillation of Ear Drops.

Precautions

1. Solution must be warm.
2. Do not use force in cleansing ear.

Procedure

Wash your hands!

1. Turn patient on his side with ear to be treated uppermost.
2. Cleanse outer ear and entrance to canal with applicator.
3. Draw warm medication up into dropper.
4. Instill number of drops ordered.
5. Have patient remain in position for 15 minutes.
6. Do not place cotton in ears unless ordered. When ordered, place piece loosely in outer ear.

Ear Irrigation

Purpose: To apply moist heat; to wash out discharges.

Equipment: Tray containing—

Rubber ear syringe or 1 ounce asepto syringe.
Curved basin.
Basin of solution (250 cc. at 105° F.).
Solution may be water, normal saline or boric acid solution.
Rubber sheet and cover.

Procedure

1. Drape covered rubber sheet over patient's shoulder.

Figure 297.—Ear Irrigation.

2. Place curved basin under ear, have patient hold it if he is able.
3. Cleanse discharge from ear.
4. Fill syringe, press bulb until solution appears at tip of syringe.
5. Tilt patient's head over basin.
6. Straighten ear canal. Adult—draw ear up and back; child—draw ear down and back.
7. Direct flow toward side of canal; use only enough force to produce a steady stream.
8. Use all solution. Dry ear when finished.

NASAL TREATMENTS

Instillation of Nose Drops

Purpose: To relieve inflammation and congestion of nasal passages.

Equipment: Medicine dropper; solution.

Figure 298.—Instillation of Nose Drops.

Procedure

1. Place patient in a sitting position with head back, or lying flat in bed, a pillow under shoulders and head tipped to the side.
2. Instill number of drops ordered.
3. Have patient hold position for 5 minutes.

Nasal Spray

Equipment: Atomizer with solution ordered.

Procedure

1. Remove air from atomizer by squeezing bulb until spray is visible.
2. Tell patient to inhale while spray is being applied. Hold atomizer so that nasal tip is at nostril.
3. Spray each nostril.

Figure 299.—Nasal Spray.

THROAT TREATMENTS

Throat Spray

Same as for nasal spray except nasal tip is removed.

Figure 300.—Throat Spray.

Throat Irrigation

Throat irrigation to be effective depends upon heat of solution, direction of solution to affected part and mechanical washing by the solution. For these reasons the patient should hold the irrigating tip and direct the flow. The solution should be as hot as he is able to take it unless a specific temperature is ordered by the doctor.

Figure 301.—Throat Irrigation.

Purpose: To relieve inflammation; to remove secretion; to apply moist heat to mucous membranes of throat.

Equipment

Tray with—

1. Irrigating can, with 3 foot tubing.
2. Glass connecting tip.
3. Stopcock.
4. Rubber tubing, 6 inches.
5. Basin.
6. Towel.
7. Pitcher of water, normal saline or 2 percent soda bicarbonate solution at 110° to 115° F.
8. Rubber sheet.
9. Paper wipes.
10. Curved basin.

Preparation of patient and equipment

1. Place patient in sitting position or turned on his side.
2. Place covered rubber sheet over chest and pin around his neck. (Pin through cover.)
3. Place basin in front of patient.
4. Connect irrigating can tubing to glass and 6 inch rubber tip. Close stopcock.
5. Fill irrigating can with solution. Open clamp, allow small amount of solution to run through tubing; clamp.
6. Instruct patient to hold head to one side, to breathe through his nose, to direct flow toward painful areas; to take frequent rest periods and not to swallow while solution is flowing.

Procedure

1. Give patient irrigating tip.
2. Raise can to 12 inches above patient's mouth, open clamp.
3. Watch patient, pinch tubing when he stops to rest.
4. When all solution is used—disconnect tubing at glass tip.
5. Place tip in curved basin.
6. Remove all equipment, leave patient clean and comfortable.

SURGICAL DRESSINGS

Review—Chapter III, "Wounds"
"Bandages and Bandaging"
Chapter VII, "The Antiseptics"

A surgical dressing has two meanings: (1) The act of covering a wound with material made of gauze and/or cotton; (2) the act of removing a dressing, treating a wound and applying a fresh dressing.

Purposes: To protect the wound from injury or infection; to absorb drainage; to inspect and/or treat a wound.

Indicated: Whenever ordered by the doctor.

Corpsman's duties in surgical dressings

1. To prepare the patient and his unit.
2. To prepare and assemble the necessary equipment.
3. To assist the doctor as required.
4. To do the dressings as required.

Rules To Observe When Handling Sterile Equipment

The following rules are based on the major principle of surgical aseptic technique which is: All articles coming in direct or indirect contact with a wound must be sterile.

1. An article is either sterile or unsterile. There is no in-between. If any doubt exists, consider it unsterile.
2. Sterile articles must be kept covered until ready for use.
3. Only the outside of the wrapper or cover is touched when opening a sterile package or container.
4. A sterile article is handled with a sterile instrument or sterile gloves.
5. Once an article is removed from a sterile container it is not returned to that container.
6. When lifting a sterile basin, slide hands under the basin.
7. When removing an article from a sterile container.

Figure 302. — Technique Forceps.

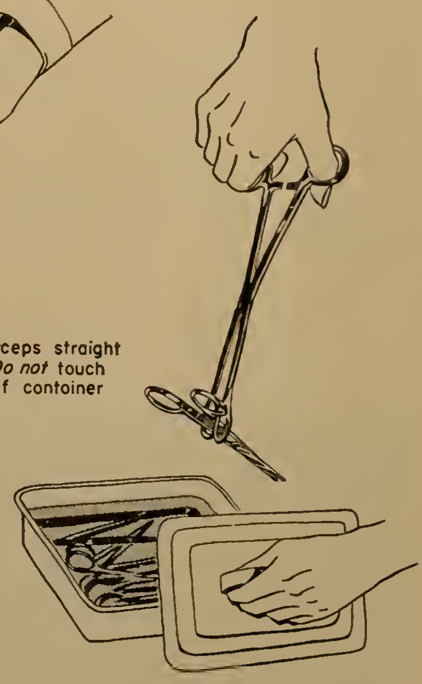

Figure 303.—Removing Article from Sterile Container.

Use technique forceps. Only that part of the container and that part of the forceps covered by the disinfecting solution may be considered sterile. Always hold tip of forceps pointing downward.

Remove the cover of the container. Hold the cover in one hand. Remove the article with the technique forceps in the other hand. Replace the cover. (If it is necessary to put down the cover, place it upside down on a flat surface.)

Replace forceps in its container—straight down and in.

8. When a container becomes contaminated, remove it at once. If it is not possible to do so immediately, invert the cover on the container to signify its contamination.

9. Avoid reaching over a sterile field.

10. Edges of sterile towels are considered unsterile after contact with an unsterile surface.

11. Keep instrument handles out of sterile field.

12. Pour sterile solutions without contact between the bottle and sponge or container.

THE DRESSING CARRIAGE

The dressing carriage serves as a portable supply table containing all the sterile and clean articles necessary for changing a series of dressings. The amount and type of supplies needed will vary according to the type of ward and the number of patients being served.

Equipment on the Dressing Carriage

Top shelf

1. Sterile containers holding:
   4 x 4 gauze flats.
   2 x 2 gauze flats.

Figure 304.—The Dressing Carriage.

   Towels or field cloths.
   Tongue blades.
   Applicators.
   Safety pins.
   Instruments.
2. Two technique forceps in separate containers three-fourths full of disinfectant solution.
3. Solutions and ointments as required for the ward.

Bottom shelf

1. Sterile packages of:
   Abdominal pads.
   Towels.
   Gloves (assorted sizes).
   Culture tubes, packing, slides, etc., as required for the ward.
2. Clean supplies:
   Curved basins.
   Paper bags.
   Tray for clean, unused dressings.
   Bandage (assorted sizes).
   Metal container of soap solution for soiled instruments.
3. Attached to bars of dressing carriage:
   Roller of adhesive tape (assorted sizes).
   Bandage scissors.
   Paper bag for used gloves and soiled towels.
4. Bucket for wastes: Line bucket with a large paper bag or several thicknesses of newspaper.

Note.—Where possible the use of individual autoclaved dressing trays from CDR is recommended. These trays may be ordered with the other supplies in the morning and stored on carriage until used.

Care of the Dressing Carriage

Daily

1. Clean and reset carriage:
   Remove all the equipment from the carriage.
   Clean and boil technique forceps, instruments, and their containers.
   Return other containers to CDR for new supply.
   Wash down the entire carriage.
   Reset carriage.
   Fill the technique forceps container three-fourths full of disinfectant solution.
   Replace equipment as listed.
   Check carriage for completeness.

After dressings are completed

1. Clean soiled instruments, boil and replace on tray.
2. Remove soiled dressings, place in burnable trash can.
3. Replenish other supplies as needed.

Weekly

1. Check the date on all sterile packages.
2. Return outdated articles to CDR.
3. Return articles not in current use to CDR.

Changing or Assisting With Dressings

Types of wounds to be dressed

Clean wounds are those made under aseptic conditions. These are usually closed wounds that heal by primary intention without infection.

Dirty or contaminated wounds are those which are infected or possibly infected. Dirty wounds are usually open, draining wounds that heal by secondary intention. Rectal and intestinal wounds are usually considered dirty because of the contamination by fecal material.

To change a dressing

Procedure

Wash your hands!

1. Bring dressing carriage to patient's bedside.
2. Screen patient. Explain procedure. Ask him to put his hands under his head and keep them there until the dressing is completed to avoid contaminating sterile field.
3. Fold back bedclothes to expose the area to be dressed.
4. Place dressing basin (lined with paper bag) on the bed to receive soiled dressings.
5. Loosen patient's dressing. To remove adhesive: press skin taut under adhesive with one hand; with other pull tape toward wound.
6. Set up sterile field, using the technique forceps to remove sterile articles from their sterile containers:

Set up sterile field, using the technic forceps to remove sterile articles from their sterile containers:

Sterile towel, open to two thicknesses, place on patient's bed near dressing or on patient's bedside table.

Figure 305.—Removing Adhesive.

Sterile 4 x 4 and 2 x 2 gauze sponges for dressing. Use judgment in setting out these supplies. (3 to 6 4 x 4's are all that are required for most dressings.)

Thumb forceps and hemostat. Place instruments so that the handles are over the edge of the towel.

7. Remove the outer dressing, inspect it, and place it in the dressing basin.
8. Pick up the thumb forceps, remove the inner dressings carefully so as not to remove a drain or tube if present; inspect the dressing. Drop into dressing basin.
9. Clean wound:

Pick up a sponge with the hemostat.

Pour solution to be used over the sponge.

Figure 306.—Removing Inner Dressing.

Figure 307.—Cleaning a Wound.

Clean incision line using rotary motion. Discard sponge. Repeat with additional sponges cleaning around the wound.

Inspect the wound. Any swelling, redness or discharge? Does the patient complain of tenderness or pain?

10. Open fold of 4 x 4's with hemostat and apply to wound.

11. Apply sterile pad if needed.

12. Cut strips of adhesive tape to fit patient. Apply adhesive tape. Secure tape on far side of dressing, pull snugly, fasten on near side.

13. Remove soiled dressings, place in bucket on carriage.

Figure 308.—Applying Sterile Dressing.

14. Place instruments in container of soap solution.

15. Place clean towel and unused dressings in tray on bottom shelf of carriage.

16. Make your patient comfortable, square away his unit.

17. Wash your hands.

To use vaseline gauze

1. Using technique forceps, remove a thumb forceps by the points from the instrument tray. Place handle of thumb forceps in doctor's hand. Replace technique forceps.

2. Remove cover from container of vaseline gauze. Doctor will remove the number of strips he needs and drop them on the patient's sterile field. Replace cover of container.

3. Using two forceps, the doctor will place the gauze as he wishes.

To remove sutures or clips

1. Add scissors to equipment.

2. Follow steps of "To Change a Dressing."

3. Paint suture line with Tr. of Merthiolate or solution ordered by the doctor.

4. Slip scissors under suture and clip close to the skin.

5. With thumb forceps, grasp suture knot and remove. Place suture on a 4 x 4. When all sutures are removed place gauze and sutures in dressing basin.

6. Clean incision with alcohol.

7. Proceed as for changing a dressing.

8. Clips are removed in the same manner using a clip remover instead of scissors.

Assisting the doctor with dressings

Preparation:

Check with the doctor; list all patients who are to be dressed.

Check the carriage. Keep enough supplies on hand to do these dressings.

Is there a need for any special equipment?

Have a plan for dressings.

Do clean, closed wounds first.

Do clean, open wounds next.

Do dirty or infected wounds last.

Inform those patients who are to be dressed.

Procedure

Follow steps of "To Change a Dressing."

Doctor will clean and inspect wound. Pay strict attention to the progress of the dressing; anticipate the doctor's needs.

He will follow the same general outline as described in "To Change a Dressing."

Charting on the nursing notes includes: Time, type of dressing, location of wound, solution used, condition of the wound, signature.

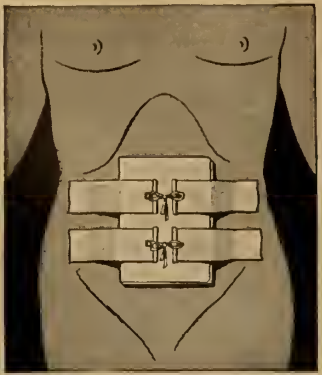

Figure 309.—Montgomery Straps.

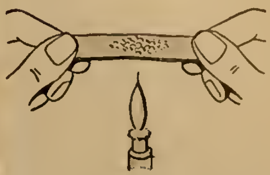

Figure 310.—Flaming Adhesive.

Attachment of Dressings

Dressings are held in place by

Adhesive tape:

Strips—straight pieces of tape of varying widths hold dressings in place and provide support to the wound.

Montgomery straps—a tie strap used when dressing must be changed frequently.

1. To make—cut adhesive of the desired width in 6–10 inch strips, number and length depending upon the size of the dressing to be held in place. Fold 2 inches of strip back on itself. Puncture or cut a small hole in this fold.

To apply strips. Place smooth side of strip on dressing, then fasten adhesive side to patient. Repeat with other strips. Thread bandage through holes in strips, tie in center. Elastic bands are sometimes used. Insert an applicator stick slightly wider than the adhesive strip and fold strip back on itself. This type of dressing attachment is useful in chest dressings since it permits the dressing to "give" when patient inhales.

Butterfly.—A small piece of tape used to bring skin edges together. The adhesive must be flamed when used over wound.

1. To make—cut a 4 inch length of 1 inch adhesive, fold adhesive tape lengthwise, cloth sides together. Narrow strip in the center by cutting out small piece.

2. To apply—light the alcohol lamp. Pass the tape back and forth through the flame of the lamp, cloth side down, until the plaster bubbles. Allow the plaster to cool. Attach tape to one side of the wound, press edges of wound together, attach tape on other side of the wound.

Cellulose tape.—This tape is used for small dressings, particularly for eye and face dressings.

Liquid adhesive or collodion.—Is used for small dressings, particularly scalp dressings.

Bandage.—See First Aid Section.

Application of Binders

A binder is a wide bandage or piece of cloth used to protect and to hold a dressing in place, to apply pressure, to give support, and to add to the patient's comfort.

Tailed—many tailed (scultetus) for abdominal or chest dressings. (T or double T—for perineal or rectal dressings.)

Figure 311.—Applying a Scultetus Binder.

Straight—for chest or abdominal dressings. When applying binders: Be sure binder is smooth under the patient; insert pins at right angles to the pull of the material; avoid placing pins over bony prominences or areas that may cause pressure.

Many tailed

Place binder under patient.

Starting at lowest tail, lap tail one over the other to the top. Pin in place.

T Binder (female patients)

Place the cross bar of the T around the patient's waist.

Bring long bar of the T around perineum to cross bar in front. Pin with safety pin.

Double T Binder (male patients)

Place the cross bar of the T around the patient's waist.

Bring double strips of T around perineum, each side of scrotum to cross bar in front. Pin with safety pin.

Wound Irrigations

Purpose: To wash out a wound; to remove debris, pus.

Equipment

1. Sterile solution basin.
2. Amount of sterile solution ordered at 105° F.
3. Sterile bulb syringe.
4. Sterile curved basin.
5. Covered rubber sheet.
6. Dressing tray or carriage.

Procedure

1. Wash your hands.
2. Tell patient what you are going to do.
3. Screen patient.
4. Ask patient to turn on his side.
5. Place covered rubber sheet under the part to be irrigated.
6. Remove dressing as directed in "Changing a dressing."
7. Place curved basin under wound.
8. Fill bulb syringe with solution.
9. Gently irrigate wound.
10. Note character, odor, appearance of discharge.
11. When all solution is used, apply a fresh dressing.
12. Make patient comfortable, square away unit.
13. Clean, wash, and boil equipment.

SUGGESTED ADDITIONAL READING—UNIT III

Eliason, Eldridge; Ferguson, L. Kraeer, and Sholtes, Lillian, *Surgical Nursing.* 9th ed. Philadelphia: J. B. Lippincott Co., 1950. pp. 119–172.

Lowsley, O. S., and Kerwin, T. J., *Urology for Nurses.* 2d ed. Philadelphia: J. B. Lippincott Co., 1948.

Montag, Mildred, and Filson, Margaret, *Nursing Arts.* Philadelphia: W. B. Saunders Co., 1948. pp. 197–228, 411–565.

Muller, Gulli L., and Dawes, Dorothy E., *Introduction to Medical Science.* 2d ed. Philadelphia: W. B. Saunders Co., 1948.

Oxygen Therapy Handbook. New York: Linde Air Products Co., 1943.

Wolf, Lulu K., *Nursing Arts.* New York: D. Appleton—Century Co., Inc., 1947. pp. 342–490.

Young, Helen Lee, Eleanor, and Associates, *Essentials of Nursing.* 2nd ed. rev. New York: G. P. Putnam's Sons, 1948. pp. 187–424.

Read current issues of periodicals for the latest information on new tests and treatments used for your patient.

Periodicals available at most stations: Armed Forces Medical Technicians Bulletin and American Journal of Nursing.

ADAPTATIONS OF NURSING CARE—UNIT IV

Nursing care of the patient is a personalized service. The quality of the care rendered by the corpsman depends upon his ability to recognize the patient's needs and to call upon his previous knowledge in adapting his care to fit the needs of the patient.

The preceding parts of this chapter have considered the supportive measures, the diagnostic and therapeutic procedures which may be applied to the patient.

This part of the chapter will discuss the adaptations and additional measures the patient may require.

In adapting nursing care remember:

1. A patient with a disease or condition is being cared for rather than a disease entity.

2. The nursing care of the patient is adapted according to the way the **patient** is **affected** by this disease or condition.

PLANNING PATIENT CARE

Review, Chapter—Units II and III

Planning the care of the individual patient may require the participation of all departments of the hospital. A special plan should be made for each patient. The nurse officer on the ward will guide you in planning such care. In most instances, the corpsman is assigned a group of patients, therefore the suggestions for patient care plans are for group practice.

1. List all the things you must do for, to, and with your patients.

2. Plan around those procedures that must be done at a specified time. (*Example:* Lunch at 1130.) Use the ward routine as a master plan.

3. Plan to give the greatest portion of your time to your sickest patients.

4. Plan to complete one thing before starting another. (*Example:* Do not start a bed bath for one patient at 0810 if you have another patient who must be in X-ray at 0815.)

Check list relating to patient's comfort.—When making a list of the care needed by your patient, it is recommended that this check list be used in conjunction with the doctor's orders, ward report book, and the patient's chart. Many of the patient's discomforts may be corrected by the alert and observant corpsman without a doctor's order.

Check the ward lights

Are they glaring?
Are they bright enough?
Are they in the patient's eyes?
Are they shaded?

Noise

Is the ward noisy?
Is there loud talking, laughing?

Ventilation of ward

Is the air fresh? Stale?
Are there odors?

Temperature of ward

Is it hot and stuffy?
What does the wall thermometer read?
Is the patient in a draft?

Check the patient's bedding

Does he have enough covers?
Does he have too many covers?
Is his bed linen clean? Wrinkled? Wet? Soiled?
Is the bottom sheet tight and smooth?
Are the top covers light and loose?

Appliances

Does the patient have a cast?
- Is there pressure anywhere?
- Are there rough edges of the cast?
- Is the cast dry?
- Are there cracks in the cast?

Is the patient in traction?
- Are the weights hanging free?
- Is he up in bed?
- Is the rope in the pulley groove?
- Is the traction pulling in the desired way?
- Is the frame causing pressure?
- Is the frame well padded?
- Is the foot or hand supported?

Skin

Is it clean?

Are there any scars? Sores? Rashes? Burns? Scratches? Bruises? Lumps?

Are there any signs of pressure? Redness? Mottling? Breakdown?

Position

Is he comfortable?

Does he move about in bed?

Has his position been changed in the past hour?

Are the rubber rings, pillows, etc., in the right places?

Intake

Is he thirsty?

Is he drinking enough water? Fruit juices?

Is his drinking water fresh? Can he reach it?

Does he have a drinking tube?

Is he eating all his food?

Is the tray attractive?

Are the dishes and silver clean?

Is he in the best position to eat?

Does he need help?

Can he reach his food?

Output

Is he voiding enough?

Does he have any difficulty or discomfort when he voids?

Does he perspire profusely?

When did he have his last bowel movement? Any difficulty?

Pain

Does he have pain? Where is it?

How long has he had it?

How severe is it?

Is he nauseated with it?

Does he have a backache? Headache?

Mental State

Does he appear worried? Afraid? Homesick? Bored? Happy? Excited? Depressed?

Sample plan for bathing four patients.—Four patients—two are bed patients requiring bed baths—two are bed patients able to help themselves.

1. Visit all four patients. Find out how they feel and what new complaints or problems they have to offer.

2. List all things you must do for, to, and with patients.

Meals.

Baths.

Trips to other departments.

Medications and treatments.

3. Start bed bath for first bed patient.

4. While he is finishing his bath (genitalia), bring equipment and water to the patient able to help himself. Strip his bed and let him start his bath.

5. Make the bed and square away the unit of the first patient.

6. Complete bath of second patient. Make his bed and square-away his unit.

7. Repeat steps 4 through 6 for the other two patients.

NOTE.—This is a general plan, it does not list the many interruptions the corpsman will probably encounter.

THE SERIOUSLY ILL OR DYING PATIENT

Review, Unit II, "Providing for the Patient's Comfort"

Serious and Critical Lists

Purpose: To notify various departments and the patient's relatives of the condition of a patient.

Indicated: When ordered by the doctor.

Procedure

1. Check station orders for the type of form used; the number of copies to be made, and the departments to receive a copy.

2. Notify the chaplain.

3. When a patient is removed from the critical or serious list by the doctor, the same procedure is followed.

Care of the Seriously Ill or Dying Patient

Purpose: To keep the patient mentally and physically comfortable.

Procedure

1. Place the patient in a light, cheerful, and well-ventilated room.

2. Keep the room quiet, clean, and clear of excess gear and equipment.

3. Speak to the patient in a calm, natural tone of voice. Continue to tell him everything you are going to do even though he may appear to be unconscious. The sense of hearing is thought to be the last faculty the patient loses.

4. Use the "Check List Relating to Comfort" in anticipating your patient's needs (pp. 257–258).

5. Give him small amounts of fluid every 1 to 2 hours if he is conscious. Do not attempt to give fluids by mouth to an unconscious patient.

6. Give mouth care every 2 hours if possible.

7. Wash and rub his back and change his position every 2 hours.

8. Give a complete bath every day and more often if he needs it.

9. Provide frequent rest periods for your patient. Do not tire your patient by taking "good care" of him!

10. Watch for the following signs of approaching death; notify ward nurse and doctor.

Failing circulation

Change in pulse—may become rapid, thready, irregular, and soft, or become very slow and soft.

Change in respiration—may become shallow and rapid or slow, gasping and edematous.

Change in temperature—body temperature may be very high or subnormal. Skin may feel very cold and moist to touch. Feet may become cold first, followed by hands, nose, and ears.

Change in color—lips and fingernails may become cyanotic; buttocks and thighs mottled.

Loss of muscle tone

May become incontinent of urine and/or feces.

Jaw sags, has difficulty in swallowing.

Loss of reflexes

Pupils fail to react to light.

Does not respond.

11. Sign of death—absence of pulse and respiration. Note time.

12. The patient is pronounced dead by the doctor.

Care of the Dead

Equipment: To equipment for bed bath, add:

One roll of absorbent cotton.
Two rolls 3-inch gauze bandage.
Three manila shipping tags.
Two sheets.
Eight safety pins.

Procedure

1. Lower the backrest, straighten the body, leave one pillow under the head.

2. Close the eyes and replace the dentures.

3. Change dressings, remove drainage tubes, close draining wounds with adhesive.

4. Bathe the body.

5. Place a pad of cotton over pubic region and rectum, secure in place with a T-binder bandage or by a piece of clean old muslin applied in diaper fashion.

6. Cross arms over chest, wrap cotton around wrists, and tie together loosely with bandage.

7. Wrap cotton around ankles and tie together loosely with bandage.

8. Make out three manila tags listing name, rate, serial number, diagnosis, ward, date and time of death.

Tie one tag to right great toe.

Tie one tag to right wrist.

9. Place a clean sheet diagonally under body. Fold upper corner of sheet over the head, lower corner over the feet, and both sides across the body. The body must be completely covered. Secure sheet with safety pins and/or bandage. Secure third manila tag on the outside of the sheet.

10. Place the body on a stretcher and cover it with another sheet. Notify the morgue watch. The body should be transferred to the morgue without disturbing the other patients.

Care of valuables

1. Inventory and itemize all patient's gear in the room.

a. Officer patient—must be done by two officers.

b. Enlisted patient—must be done by officer and one enlisted person.

2. Check station orders for additional instructions.

Care of the room or unit

See "Cleaning of bedside unit."

NOTE.—For patients who have died of communicable disease—write "COMMUNICABLE DISEASE" in large red letters on manila tag.

CARE OF THE PATIENT ON THE MEDICAL SERVICE

Review—Chapter IV, Unit II, "Basic Nursing Care"

Unit III, "Diagnostic and Therapeutic Procedures"

Chapter V, "Diet in Disease"

Chapter VI, "The Nature of Communicable Diseases"

"The Body's Defense Against Disease"

Chapter VII, Review section applicable to the particular patient

Patients on the medical service are those whose conditions are treated by medication and/or treatments other than surgical intervention.

The adaptation of nursing care to fit the needs of the patient on the medical service will be governed by the patient's condition and the treatment prescribed by the doctor. The patient's treatment may consist of either complete bed rest, a special diet, a specific medication or treatment, or combination of these methods.

In the care of the patient on the medical service, the corpsman should know:

1. How to give basic nursing care with particular emphasis on:
   - Keeping the patient clean and comfortable.
   - Protecting the patient and others from infection.
2. How to assist with diagnostic and therapeutic tests and examinations.
3. How much and why the patient's activities are limited.
4. Why a specific diet is prescribed. What foods are to be included or excluded.
5. Why a particular medication or treatment has been ordered. What desired effects are to be expected; what untoward effects he should be alert to observe.

THE PATIENT WITH DIABETES

Diabetes is a metabolic disorder probably due to a deficiency of insulin production by the islet cells of the pancreas. The treatment of the diabetic patient consists of the control of the condition by diet therapy and insulin administration.

The corpsman's duties in the care of the diabetic patient:

1. Basic nursing care with particular emphasis on personal cleanliness and preventing the spread of infection.
2. Attention to diet. See diabetic diets, p. 325.
3. Laboratory test. See diagnostic tests—urinalysis and blood tests, pp. 197–198; 200.
4. Administration of insulin. See hypodermic injections, pp. 208–211.
5. Close observation of the patient to prevent insulin shock or diabetic coma.

Insulin shock—due to too little food or overdose of insulin:

Symptoms

Weakness, pallor, profuse perspiration.
Hunger, dizziness, apprehension.
Nervousness and tremor.
Convulsions and coma, if untreated.

Treatment

Give sugar in some form such as orange juice, sugar cubes, candy.

Apply blankets.

Notify doctor.

Prepare equipment for an intravenous injection of 50 percent glucose by the doctor if the patient is unconscious.

Impending diabetic coma—due to too much food or too little insulin:

Symptoms

Loss of appetite, headache.
Listlessness and drowsiness.
Nausea and vomiting.
Sugar, acetone and diacetic acid in urine.
"Fruity" odor to breath.

Treatment

Notify doctor at once.
Apply blankets.

Regular insulin as ordered.

Prepare equipment for an intravenous injection of regular insulin by doctor if patient is unconscious.

6. Teaching the patient. The patient with diabetes will have to learn to live with his condition. His life can be a normal one with adjustments on his part in the matter of personal hygiene, diet, exercise, rest, and insulin administration. The corpsman can help his patient accept these limitations by:

Encouraging the patient to stay on the diet prescribed by the doctor.

Stressing the importance of personal hygiene with special emphasis on the care of the skin, teeth, and feet.

Teaching the patient how to administer insulin to himself.

Teaching the patient how to test his urine for sugar.

Teaching the patient how to recognize the early symptoms of insulin shock and diabetic coma and what treatment to institute.

THE PATIENT WITH A CARDIAC CONDITION

The following are items of care needed by patients with cardiac conditions. The treatment of the patient with a specific cardiac condition will be ordered by the doctor.

The treatment of the patient usually consists of complete bed rest, supportive care, and administration of medication.

The corpsman's duties in the care of the patient are:

1. Complete bed rest for patient.

   Assist patient with his oral hygiene, p. 184.

   Bathe the patient, pp. 186–187.

   Feed the patient, p. 191.

   Keep patient comfortable. See positions and devices for comfort, pp. 180–182.

   Assist with bedpan and urinal, p. 188.

   Allay fears and anxieties by prompt and cheerful service. The patient must be saved from even thinking for himself.

3. Attention to diet. See "Cardiac diets," p. 326.

3. Regulation of fluids as prescribed. See "Intake and output," p. 188.

4. Administration of medicines, pp. 204–206.

   Precautions in administering digitalis.

   (1) Keep an accurate record of total dosage.

   (2) Take the patient's pulse before giving drugs, report pulse rate below 60 a minute and do not give drug unless specifically instructed.

   (3) Watch for symptoms of nausea and vomiting.

   Other drugs such as opiates, sedatives, and diuretics may be prescribed. Follow directions accurately, carefully observe and record effects.

5. Close observation of the patient.

   Edema—may appear in buttocks, legs, and ankles.

   Dyspnea—support the patient in the position he finds most favorable.

   Pulse—note the rate, force, rhythm and volume when taking a pulse. Count for full minute.

   Cyanosis—may appear about the lips, fingernails or buttocks. Oxygen may be ordered. See Administration of Oxygen, pp. 213–219.

   Pressure sores. See Care of Bed Sores, pp. 189–190.

6. Teaching the patient.

The patient will have to learn to live within the limitations set by his condition. The corpsman can help his patient by:

Encouraging the patient to accept these limitations.

Showing him the importance of rest and moderation in all activities.

Teaching him the importance of avoiding over-exciting stories, movies, and company.

Teaching him the need of carrying and knowing how to use the medications ordered by the doctor.

THE PATIENT WITH A COMMUNICABLE DISEASE

There may be patients in a sick bay or hospital ward who are carriers of disease or whose communicable diseases are hidden by other conditions.

Most of the communicable diseases start with symptoms of a common cold or a gastrointestinal upset. When any patient presents these symptoms, use precautionary measures until a diagnosis is established.

The care of the patient with a communicable disease is essentially the same as for any other

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patient with the addition of medical aseptic techniques.

The extent of medical aseptic technique required for a patient with a communicable disease will depend upon the modes of transmission, the source of infection and the period of communicability of the disease.

Modes of transmission

1. Through direct contact, by actually touching an infected person or natural source of infection, including transmission through air by droplets for short distance.

2. Through indirect contact:

a. By means of contaminated surfaces, articles, or vehicles of infection.

b. By air convection usually only for short time and distance.

c. By anthropod or animal vectors.

Sources of infection

Reservoir—one or more species of animal or plant in which an infectious agent lives and multiplies and depends principally for survival.

Vector—an anthropod or other invertebrate that conveys the infectious agent from a person or animal to another person or animal. Insects, spiders, mosquitoes, lice, ticks may be vectors.

Vehicle—matter in or upon which infectious agents are present or survive until there is physical contact with persons.

Medical Aseptic Technique [23]

Purpose: To confine the disease to the patient and to protect the worker and other patients from the infection. To protect the patient from new infection or reinfection.

Isolation:

For a unit in a noncommunicable disease ward:

Select a part of the sick bay or ward that can be set up as an independent unit. A single room with running water is most desirable. Establish a zone around this area as contaminated. Be sure all personnel and other patients know and understand the limit of this zone.

[23] Adapted from: (a) *Safer Ways In Nursing,* New York: National Tuberculosis Association and National League of Nursing Education, 1948. (b) M10–2. *Basic Principles of Aseptic Technique,* Washington: Veterans' Administration, 1946. (c) Questionnaires. *Communicable Disease Techniques:* Naval Hospitals, 1950.

Equipment for unit

For patient's use

Thermometer and holder.

Paper bag and wipes.

Bath basin.

Curved basin, glass, toothbrush and dentifrice.

Bedpan and urinal.

Razor, shaving cream, mirror.

Wastebasket lined with large bag, or two thicknesses of newspaper.

For worker's use

At entrance to unit (inside unit).

Extra bedside stand with set up for masks if they are to be used.

Set up for handwashing if sink is not available.

Standard for gown.

Hamper.

For a unit in a communicable disease ward

1. Establish zones within the ward as contaminated, sometimes contaminated, and clean areas.

Clean areas—doctor's office, nurses' station, between cubicles, supply lockers, telephones.

Sometimes contaminated zones—examining room, dish-sterilization room, utility room. These areas must be washed with soap and water and aired before being considered not contaminated.

Contaminated zones—the immediate surroundings of the patient, the cubicle, the patient's solarium, the lavatory and showers connected with the cubicle. All floors, inside of sinks and hoppers are considered contaminated.

Be sure all personnel and patients know the limits of these zones.

It may be helpful to designate and name the zones as:

Red zone.—Contaminated zone. Everything within this zone must be sterilized or disinfected.

Blue zone.—Sometimes contaminated. Everything used for the patient must be sterilized or disinfected.

White zone.—Clean zone—nothing is brought into this zone from the red without being disinfected or sterilized. Gowns and masks are not worn in the white zone except when cleaning.

2. Group patients in cubicles according to their diagnoses:

Patients with respiratory diseases together.

Patients with gastrointestinal diseases together.

Patients with diseases carried by vectors together.

Patients with highly communicable diseases should be placed in separate rooms.

3. Each cubicle should be considered as a separate unit. Each unit should have facilities for handwashing and gown technique at the entrance.

Cleaning

Keep down dust. Use sweeping compound or swab and buff decks; damp-dust furniture; wear gown and mask when cleaning and damp-dusting; follow daily and weekly cleaning schedules. (See "Ward Management.")

Ventilation

Fresh air is particularly important in a communicable disease ward. There should be cross ventilation present all the time and the ward should be aired at least twice a day.

Handwashing Technique [24]

Methods

Using sink with running water.—Hands and forearms are well lathered with soap, rubbed vigorously particularly around fingers and nails and rinsed with hands held down to allow water to drain off finger tips. Hands and arms are dried with paper towels.

Using basin.—To be used only when a sink is not within reasonable distance of unit.

Suggested set-up: Bedside locker; bath basin; pitcher; pail with step-on cover; paper towels; soap in soap dish; wastebasket.

Method

1. Pour water into basin from pitcher before entering unit.
2. Wash and dry hands as described above.
3. Holding basin on the outside, discard water into pail.
4. Using a second paper towel, wipe inside of basin.
5. Wash hands under running water as soon as possible.

When hands are washed

1. Before and after removing gown.
2. Before and after medications or treatments.
3. Before and after passing nourishments, water, or trays.
4. Before going to meals or leaving ward.
5. Before and after each task.

[24] The supply catalog lists soap and detergents with 3 percent hexachlorophene in cake and liquid form.

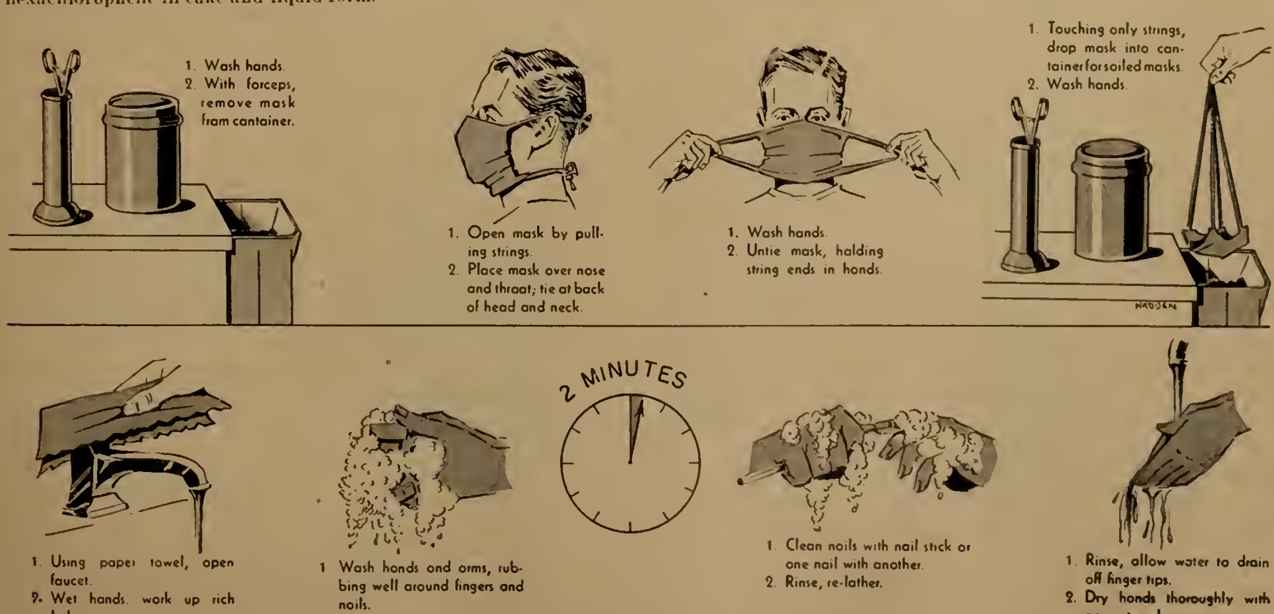

Figure 312.—Mask and Hand Washing Technique.

Mask Technique

Method

1. Masks are washed, rolled, placed in a metal container and autoclaved.
2. A mask is used once and then placed in used mask receptacle.
3. A mask is worn until it becomes moist or for 20 to 45 minutes.
4. **Once** a mask is **moist,** it is **contaminated.** Do not put the mask in your pocket, leave it on a desk, or leave it dangling around your neck! Get rid of it!

Gown Technique

Methods

1. **Discard** gown method is recommended:

   A clean gown is used each time it is necessary to enter the unit.

   Gown is removed, folded clean side out, and placed in hamper.

   Used gowns may be autoclaved or sent to laundry.

   Supply of clean gowns may be stored in bedside table at entrance to unit.

2. **Single** gown method:

   A gown is hung at entrance to unit. It is used by all personnel caring for the patient.

   When gown is removed, it is folded lengthwise, contaminated side out, and hung on standard.

3. **Group** gown method: This may be used where all patients on a ward have the same disease.

   A gown room is provided. This room should be near the entrance of the ward. Each member of the ward staff is assigned a hook on the gown rack.

   Equipment of gown room.

   A rack with sufficient hooks for each member of the staff. The hooks are labeled with each member's name.

   Shelves for clean supplies (gowns, masks, paper towels, soap).

   Cabinets for workers' clothes.

   Scrub sink with knee levers and foot operated soap dispenser.

   Set-up for masks at entrance to room.

   Method

   A clean gown is used daily.

   When not in use, the gown is hung clean side out on the worker's personal hook.

When gowns are worn

1. When giving contact care; changing, sorting, or handling soiled linen. When sweeping and/or cleaning in the unit.
2. Contact care is the care of the patient and his immediate surroundings. It includes bed baths, bed making, back rubs, treatments and taking temperatures. Serving trays, nourishments and medications ordinarily do not require a gown unless the patient needs assistance.
3. All non-nursing personnel (i. e., doctors, physical and occupational therapists, librarians, etc.) should wear gowns when in contact with the patient. Use discard gown method.
4. Visitors who spend long hours at the bedside of a seriously or critically ill patient should wear gowns. Use discard gown method.

Glove Technique

Method

1. Wash hands.
2. Gloves should be initially sterile.
3. Put on gloves before entering unit.
4. After use, wash gloves under running water.
5. Boil for 5 minutes before returning to circulation.

When gloves are worn.—When doing contact care for patients with syphilitic rashes, smallpox, and when handling dressings of patients with tetanus or gas gangrene.

Goggles

Method.—Wash goggles with soap and water between each use.

When goggles are worn.—When doing irrigations of infected eyes or whenever there is a possibility of the worker being exposed to a spray carrying infectious material.

Handling Linen

Method

1. General:

   All soiled linen should be handled as little as possible.

   Avoid flicking linen about.

   Place linen in hamper or laundry bag directly from the patient's bed.

Donning Gown

1. Remove jumper; wash hands; put on mask.
2. With palms together, slip hands inside gown; remove from hook.

1. Touching only inside of gown, work arms and hands through sleeves.
2. Place finger inside neckband, draw gown into place.

1. Tie gown at neckband in back.
2. Grasp back edges of gown, bring to center back.

1. Lap edges of gown together at back. Hold flap in place.
2. Grasp belt end with free hand, bring to back.

1. Bring other belt end to back.
2. Tie belt at back tightly enough to keep flap in place.

1. Shrug shoulders once or twice to give sufficient working room.
2. Push up sleeves of gown to convenient working level.

Removing Gown

1. Untie belt, push sleeves to 2 inches above contaminated area.
2. Wash hands and arms without touching cuffs of gown.
3. Place 2 fingers under cuff, pull sleeve down over hand without touching outside of gown.

1. With hand inside sleeve, draw other sleeve down over hand.
2. Slip out of gown by working hands up to shoulder seams of gown.

1. Keeping hands inside, lift gown off shoulders.
2. Fold gown by bringing palms together at shoulder seams of gown.

1. Withdraw one hand, grasp gown just below neckband at center front.
2. Withdraw other hand, bring back edges of gown together just below neckband.
3. Hang gown on hook, contaminated side out.

Figure 313.—Donning And Removing Gown—Medical Aseptic Technique.

2. Isolated unit on a **noncommunicable disease** ward:

Place laundry bag over the back of a chair inside the unit.

Place contaminated linen in laundry bag as you remove it from the bed.

Close laundry bag.

Place bag inside clean bag held by clean corpsman at the entrance to the unit.

Clean corpsman turns down an 8-inch cuff on clean bag.

Clean corpsman holds the clean bag under the cuff.

After the contaminated linen is placed in the bag, the clean corpsman closes the bag by turning up the cuff from the outside.

Clean corpsman ties a shipping tag labeled "contaminated" on outside of bag.

Send bag to laundry.

3. On a **communicable disease ward:**

Provide a hamper for each cubicle.

Place linen in hamper for each cubicle.

Close hamper bags; label "contaminated."

Send bags to laundry at specified time.

When counting and sorting linen before laundering is required:

Figure 314.—Handling Contaminated Linen.

Wear gown and mask.

Spread clean sheet on deck.

Remove and sort each piece of linen. Do not flick or toss linen about.

Place clean sheet in linen carrier; place sorted linen inside sheet. Label carrier "contaminated."

Take or send carrier to laundry at specified times.

When necessary.—For all patients on a communicable disease ward.

Handling Excreta (Feces, Urine, Vomitus) Requiring Additional Disinfection

Method.—Use one of these disinfectants: Cresol 4 percent; benzalkonium chloride 1 percent.

1. Prepare a section of the utility room by placing several thicknesses of newspaper on deck.
2. Use bedpan as a container.
3. With tongue blades, break up solids to permit penetration by disinfectant.
4. Add equal amount of disinfectant to excreta; cover and allow to stand for 1 hour.
5. Write on a piece of paper the time the disinfectant was added.
6. After an hour, place bedpan in automatic flusher; flush and steam pan for 1 minute.

When necessary.—For patients with amoebic and bacillary dysentery, cholera, typhoid fever, and poliomyelitis—when a municipal sewerage system is not available.

Handling Discharges From Nose and Throat

Method

1. Isolated unit in a **noncommunicable disease ward:**

Pin paper bag to patient's bed.

Supply patient with paper tissues. Provide sputum cup if patient is expectorating large amounts of sputum.

Instruct patient:

To cover his mouth and nose with tissues held in a cup-like fashion whenever he coughs, sneezes, talks to people.

To place used tissues in the paper bag on his bed.

To ask for new sputum cup when one is half-full.

To place several tissues in top of sputum cup, place cup in paper bag, unpin bag, and close top of bag.

Hold clean paper bag; ask patient to drop his bag into clean one. Close top tightly; place in burnable trash can or directly into incinerator.

Wash your hands!

Provide patient with new bag, sputum cup, tissues if needed.

2. For group of patients on **communicable disease ward:**

Set up utility cart:

Top shelf—large waxed paper bags for patients' bags. String or bandage to tie wax bags.

Bottom shelf—clean paper bags for beds, sputum cups, tissues.

Collection.[25]

Instruct patients as above.

Keep one hand clean for distributing clean supplies, one hand contaminated for collecting used supplies.

Place used bags into large waxed bags—4 patients' bags to 1 waxed bag.

When all are collected, tie waxed bags securely at top.

Place all bags in burnable trash can for immediate incineration.

Wash down utility cart with soap and water, rubbing vigorously for 2 minutes.

When necessary

When caring for patients whose diseases are spread by nose and throat discharges.

Handling Food Trays

Isolation tray in a noncommunicable disease ward

1. Make two areas for tray in the utility room by spreading several thicknesses of newspaper to full sheet size.
2. Bring tray from patient's room and place it on one area.
3. Scrape solids from dishes with knife or paper tray cover onto other area.
4. Open bedpan sterilizer with foot pedal; pour fluids down sterilizer.
5. Wrap solids in one thickness of newspaper.
6. With paper towel, push flush valve of bedpan sterilizer and open faucet in sink.
7. Wash your hands thoroughly!
8. Push down steam valve of bedpan sterilizer. Wrap solids in newspaper, touching only the outside of the paper. Place in burnable trash can.
9. Take tray on newspaper to dish carrier for main galley.
10. Wash your hands!

On communicable disease wards

1. Set up utility cart with pails for solids and liquids.
2. Collect, scrape, and stack each tray.
3. Bring cart to door of dish-sterilizing room.
4. Wash dishes in hot soapy water.
5. Place dishes, etc., on sides in slotted racks of sterilizer.
6. Follow directions on sterilizer, watch temperature gage (180° F.), and time accurately!
7. Allow dishes to air dry.
8. Wash utility cart and shelves on contaminated side of sterilizer vigorously with soap and water for 2 minutes.

When necessary.—For patients with diseases spread by discharges from the nose and throat and gastrointestinal tract.

Thermometer Technique

Method

1. Isolated unit on a **noncommunicable disease ward:**

Keep the thermometer at the patient's bedside in a large test tube filled with 70 percent alcohol. Protect the thermometer tip by placing a small amount of cotton in the bottom of the test tube.

Strap the test tube to the foot of the bed with adhesive.

Taking the TPR.

Take a paper cup containing a cotton square moistened with water into the unit.

Remove the thermometer from test tube; wipe down with cotton. Read and shake down thermometer.

Place thermometer in patient's mouth.

Take his pulse and respiration.

After three minutes, remove the thermometer from patient's mouth, wipe down in

[25] Where patients are not able to assist, distribute clean supplies first. Carry out procedure for patients' bags; both your hands are contaminated.

rotary motion with cotton, place cotton in paper cup. Read thermometer and place it in test tube.

Discard paper cup in patient's waste basket.

Wash your hands!

Record TPR in book at once.

Care of the thermometer:

Keep tube filled with alcohol 70 percent at all times.

Twice weekly—remove tube from bed, take to utility room. Wash thermometer and fill tube with alcohol. Restrap tube with thermometer to foot of patient's bed.

2. On a **communicable disease ward**

In utility room:

Thermometer tray containing

Covered catheter tray filled with 70 percent alcohol and containing enough thermometers for ALL patients.

Container for water.

Container for soap solution.

Container for cotton squares.

Sputum cup for waste cotton.

Preparation of equipment: Use a wheeled cart.

Fill containers with water, soap solution, and cotton. Place on cart.

Remove thermometers from alcohol, rinse under running water, and place in container of water.

Procedure in ward:

Pick up TPR book and pencil as you pass nurses' desk. Plan to take convalescent patients' TPR first (negative patients on tuberculosis service).

Distribute 3 thermometers at a time (see TPR routine).

Place each thermometer in soap solution after it is read.

When all temperatures have been taken, wheel cart to utility room.

Wash each thermometer under running water, wipe down in rotary motion with cotton and place on paper towel.

When all thermometers are washed, place them in the container of alcohol 70 percent.

Wash water and soap solution containers. Place them upside down on the tray.

Discard waste.

Wash wheeled cart vigorously for 2 minutes with soap and water.

Wash your hands!

Daily

Strip tray; place thermometers on paper towel.

Filter alcohol.

Boil containers for 10 minutes (alcohol, water, soap solution, and cotton containers).

Reset tray, refill alcohol and cotton containers and replace thermometers in alcohol.

Terminal Disinfection

1. Ordinary cleaning as described in cleaning a bedside unit is all that is necessary in most instances. Air all units for 24 hours after patient's discharge.

2. *Exception.*—Patient discharged by death due to active communicable disease.

Use isolation technique in disposal of linen and equipment.

Wash walls with soap and water to height of 6 feet.

Air unit for 24 hours.

Table V.—CHART OF SELECTED COMMUNICABLE DISEASES

Disease and causative organism	Source of infection, mode of transmission	Incubation period, communicable period	Common symptoms, possible complications	Points in nursing care
CHICKEN POX **(Varicella)** Caused by virus	*Source:* Secretions of skin lesions, nose and throat infected persons. *Spread:* By direct contact with discharges from lesions, nose, and throat of infected persons. Indirectly by articles freshly soiled with such discharges.	*Incubation:* 2–3 weeks. *Communicable:* From one day before until 6 days after the appearance of first crop of vesicles.	*Symptoms:* Mild chill and fever. Pain in back and legs. Maculopapular rash appears in 24 hours, followed by vesicular rash lasting 3–4 days. Rash first appears on trunk and covered portions of body. Different stages of rash may be on same region of body at same time. *Complications:* Secondary skin infection, pneumonia, conjunctivitis.	Isolate in separate room. Complete bed rest until 24 hours after temperature returns to normal. Caution patient against scratching lesions. Pat, rather than rub, skin dry when bathing patient. Use care in combing his hair. Avoid loosening scabs. Ointments, if ordered, may be applied to skin for relief of itching. Force fluids. Diet as desired. *Disinfection:* All articles in contact with discharges. Incinerate paper handerchiefs and dressings soiled with discharges.
COMMON COLD Caused by one or more viruses	*Source:* Secretions from nose and throat of infectious persons. *Spread:* By direct contact with infected person. By cough or sneeze of infected person. Indirectly by articles freshly soiled with nose and throat discharges.	*Incubation:* 42–72 hours. *Communicable:* During incubation and early stage of disease.	*Symptoms:* Sudden onset; slight fever, chilly sensations, coryza, general lassitude, vague aches and pains in back and limbs. *Complications:* Bronchitis, pneumonia, sinusitis, otitis media.	Isolation as can be accomplished by bed rest during the acute stage. Caution patient against violent nose blowing. Apply cold cream or bland ointment to upper lip and about nares. Force fluids. Diet as desired. *Disinfections:* All articles in contact with discharges. Incinerate paper handkerchiefs soiled with discharges.
DIPHTHERIA Caused by Klebs Loeffler bacillus	*Source:* Discharges from nose, throat, nasopharynx of infected person or carrier. Also contaminated milk. *Spread:* By direct contact with discharges from infected person or carrier. Indirectly by articles freshly soiled with nose and throat discharges. Also by contaminated milk.	*Incubation:* 2–5 days. *Communicable:* Until bacilli disappear from secretions and lesions, usually 2–4 weeks.	*Symptoms:* Slight sore throat, moderate fever; hoarseness; dry tight cough; malaise; increased pulse rate out of proportion to temperature; grayish white membraneous patch on mucous membrane of throat and upper respiratory passages; restlessness; dyspnea; cyanosis. *Complications:* Bronchopneumonia, suffocation, myocarditis, paralysis of muscles used in swallowing and breathing, otitis media.	Isolation in separate room until 2 cultures from nose and 2 from throat are negative. Complete bed rest for 2–3 weeks or until all danger is past. Watch skin for petechiae (tiny hemorrhages under the skin) watch for signs of choking. Have suction at hand. Give frequent oral hygiene. Hot throat irrigations may give comfort. Force fluids. Diet of semi-solids or as tolerated. *Disinfection:* All articles in contact with patient.
INFLUENZA Caused by influenza virus	*Source:* Probably discharges from mouth and nose of infected person or carrier. *Spread:* By direct contact with discharges and droplet infection from infected person or carrier. Air borne? Indirectly by articles freshly soiled by discharges.	*Incubation:* 24–72 hours. *Communicable:* Possibly from incubation until after fever subsides.	*Symptoms:* Chills, fever, malaise, generalized aches and pains, intense headache, cough, sputum scant and watery at first, increases in amount and becomes mucopurlent; mental depression, prostration out of proportion to symptoms. *Complications:* Bronchitis, acute sinusitis, otitis media, pneumonia.	Isolation in separate room or ward. Complete bed rest until 24 hours after temperature returns to normal. Tepid sponges to refresh patient. Ice cap to relieve headache. Warm gargles may relieve throat irritation. Steam inhalations may relieve cough. Maintain cheerful attitude toward patient; keep room light and pleasant. Force fluids, diet as desired. *Disinfection:* All articles in contact with nose and throat discharges. Incinerate paper handkerchiefs.
MEASLES (Ruheola) Caused by a virus	*Source:* Secretions from nose, throat, eyes. *Spread:* By direct contact with infected person; by droplet. Indirectly by articles freshly soiled with discharges from mouth, nose and eyes.	*Incubation:* 10 days from exposure to onset of fever; 13–15 days to appearance of rash. *Communicable:* From 4 days before until 5 days after appearance of rash.	*Symptoms:* Coryza, sneezing, cough, nausea, vomiting, chilliness, fever, small grayish white spots at gumline (Koplik spots). Rash appears third or fourth day; starts about ears, face, trunk and extremeties. Fever increases during eruption, subsides as rash fades. *Complications:* Bronchitis, pneumonia, otitis media.	Isolate in light airy room during period of communicability. Avoid direct or glaring light; protect patient from drafts. Complete bed rest until temperature returns to normal. When bathing use very little soap, pat rather than rub skin dry. Itching skin may be relieved by a 5 percent solution of sodium bicarbonate. Petrolatum may be applied about nares and lips. Offer mouth wash and gargles frequently. *Disinfection:* All articles in contact with discharges. Incinerate paper handkerchiefs and dressings soiled with discharge from nose, throat, eyes.

[1] Sources.—Teresa Lynch, *Communicable Disease Nursing* (St. Louis, C. V. Mosby Co, 2d Ed.) 1949. Helen Young, (ed.) *Lippincott's Quick Reference Book, For Nurses* (Philadelphia, J. B. Lippincott, 6th ed.) 1950. *The Control of Communicable Disease in Man* 7th ed. (Washington, D. C., Federal Security Agency, USPHS) 1950.

Table V.—CHART OF SELECTED COMMUNICABLE DISEASES—Continued

Disease and causative organism	Source of infection, mode of transmission	Incubation period, communicable period	Common symptoms, possible complications	Points in nursing care
MENINGOCOCCUS MENINGITIS **(Cerebrospinal Fever)** Caused by cocci	*Source:* Discharges from nose and throat of patient and carriers. *Spread:* By direct contact with patient or carriers. Indirectly by articles freshly soiled with infectious discharges.	*Incubation:* 2–10 days. *Communicable:* Until nose and throat discharges are negative for meningococci.	*Symptoms:* Sudden onset; fever, intense headache, nausea, vomiting, petechial skin rash; neck becomes stiff; patient stuporous or lapses into coma. Patient may assume oposthotones position (spine arched backward to an extreme degree). *Complications:* Pneumonia.	Isolate in quiet, slightly darkened room. Change patient's position frequently. Use small pillows and other devices for comfort. Patient is very sensitive to noise, light and touch. Handle him gently. Give frequent back care to avoid pressure sores. Give oral hygiene before and after feeding. Apply ointment about lips. Protect eyes from bright lights. *Disinfection:* All articles soiled by nose and throat discharges. Incinerate paper handkerchiefs.
MUMPS **(Infectious Parotitis)** Caused by virus of mumps	*Source:* Saliva of infected person. *Spread:* By droplet and direct contact with infected person. Indirectly by articles freshly soiled with saliva of such person.	*Incubation:* 12–26 days. *Communicable:* From 2 days before until swelling of glands have subsided.	*Symptoms:* Chilliness, malaise, moderate fever, pain on swallowing and chewing. Swelling below and in front of ear. The surrounding tissues are edematous; the submaxillary glands often swollen and tender. Features are distorted. Movements of jaw are restricted and painful. May affect one or both sides. *Complications:* Orchitis, oophoritis, pancreatitis, mastitis.	Isolation for period of communicability. Complete bed rest until after swelling has subsided. Heat or cold may be applied to affected (patient's preference). Special mouth care with frequent mouth washes or gargles. Force fluids and semi solids. Avoid acid fruit juices. A scrotal bridge may be ordered for male patient. *Disinfection:* All articles in contact with nose and mouth discharges. Incinerate paper handkerchiefs.
PERTUSSIS **(Whooping Cough)** Caused by pertussis bacillus	*Source:* Discharges from throat of infected persons. *Spread:* By direct contact with infected persons, by droplet infection. Indirectly by articles freshly soiled with such discharges.	*Incubation:* 7–10 days. *Communicable:* From onset of first symptoms until "whoop" appears.	*Symptoms:* Chilliness, malaise, moderate fever, coryza, dry hacking cough. Cough gradually becomes severe until characteristic whoop is noted. The paroxysmal stage is marked by coughing at intervals of varying frequency. Repeated paroxsyms of coughing, loss of breath, whooping, and vomiting leave the patient exhausted, perspiring and apparently dazed. *Complications:* Bronchopneumonia, hernia, hemorrhage, prolapse of rectum, convulsions.	Isolation in a separate, well-ventilated room. Patient should be kept quiet. Tight abdominal binder may give some support during paroxysms. Serve bland nourishing foods, neither very hot nor very cold. If patient vomits soon after eating, feed again. *Disinfection:* All articles soiled with discharges from nose and throat. Incinerate paper handkerchiefs.
PNEUMONIA A. Acute lobar. Caused by pneumococci	*Source:* Probably discharges from nose and mouth of infected persons. *Spread:* By direct contact with infected person. Indirectly by articles freshly soiled by such discharges.	*Incubation:* Possibly 1–3 days. *Communicable.* Unknown, thought to be until organisms no longer present in discharges. Possibly by minute suspended particles containing infectious agent.	*Symptoms:* Abrupt onset with chill. Rapid rise in temperature to 104°–106° F; Skin hot and dry; malaise and headache; Pain in chest; Patient lies on affected side. Flushed face, cyanoisis about lips. Herpes on lips. Increased respirations with respiratory grunt. Cough with tenacious rusty sputum. Pulse full and bounding. Delirium may be present. *Complications:* Spread to another part of lung, pleurisy with effusion, empyema, pericarditis, endocarditis, meningitis.	Isolate patient in a separate, warm well-ventilated room free from drafts. Encourage patient to rest and relax. Complete bed rest is basic treatment. Plan procedures so as to disturb patient as little as possible. Change position every 3–4 hours. Daily bath, occasional back rub with lanolin or cocoa butter for elderly patients may prevent dry itching skin. Special mouth care every 3 hours. Apply ointment to lips to keep them soft. Force fluids. Diet as desired. See "Oxygen Therapy" for administration of oxygen. *Disinfection:* All articles soiled by nose and throat discharges. Incinerate paper handkerchiefs.
B. Primary atypical. Caused by virus	*Source:* Discharges from the nose and throat. *Spread:* By direct contact with infected person. Indirectly by articles freshly soiled by nose and throat discharges. Mild unrecognized infections may help spread of disease.	*Incubation:* Not definite, may be 7–21 days. *Communicable:* Unknown length of time.	*Symptoms:* Chilliness, fatigue, malaise, fever, range 99°–104°F. Intense headache. Painful and exhausting cough with scant sputum. *Complications:* Pericarditis, pleurisy, empyema, encephalitis.	Similar to points listed under "A", bed rest for several days after temperature returns to normal.

Table V.—CHART OF SELECTED COMMUNICABLE DISEASES—Continued

Disease and causative organism	Source of infection, mode of transmission	Incubation period, communicable period	Common symptoms, possible complications	Points in nursing care
POLIOMYELITIS (Infantile Paralysis) Caused by virus of poliomyelitis	*Source:* Discharges from nose, throat, intestinal tract of acutely ill and/or convalescent patient, carrier. *Spread:* Not definite. Close association with infected persons. Portal of entry may be nose and throat or gastrointestinal tract.	*Incubation:* Usually 7–14 days. May be 3–35 days. *Communicable:* Latter part of incubation period and first week of illness (not definite).	*Symptoms:* Three stages. First stage: Gastrointestinal upset, fever, headache, malaise. Second stage: Meningeal irritation, severe headache, pain and stiffness in back of neck and limbs, muscle spasm. Third stage: Severe involvement of nervous system, paralysis. Patient may progress to all three stages, or disease may be limited to first and/or second stage. Often paralysis is the first sign of the disease. *Complications:* Atelectasis and pneumonia in patient with respiratory paralysis. Renal calculi, atrophy of paralyzed muscles.	Isolation in separate ward or room. Complete bed rest on a firm bed. Place fracture board under mattress. Use a covered footboard separated from mattress by blocks to prevent pressure of bedding on toes and to provide firm base for soles of feet when patient is in prone position. See "Positions for comfort." Woolen or cotton blankets should be next to patient. Physical and mental rest are essential; avoid drafts and glaring lights. Corpsman's hands should be warm when touching patient. In the acute stage, support patient's body in the position he assumes (first 24–48 hours). Later maintain body in good alinement. Baths are frequently omitted during acute stage. When bathing, use gentle sponging movements and dry by blotting rather than rubbing. Fluids during acute stage, diet as desired later. Give hypertonic fluids when hot packs are ordered (usually) as soon as diagnosis is made. See "Lay on packs." Watch for nasal voice, hoarseness, difficulty in swallowing, twitching of facial muscles characteristic of bulbar type. Should respiratory paralysis develop, patient may be placed in a respirator. *Disinfection:* All articles soiled by nose and throat discharges. Incinerate paper handkerchiefs. If municipal sewerage is not available, disinfect feces before disposal.
SCARLET FEVER Caused by hemolytic streptococci	*Source:* Discharges from nose and throat, abscesses, wounds of infected persons. Also carriers. *Spread:* Direct contact with patient or carrier. May be airborne. Articles freshly soiled by discharges of infected person or carrier, by contaminated milk and milk products.	*Incubation:* Usually 2–5 days. *Communicable:* Until few days past clinical recovery, all abnormal discharges stopped, open sores or wounds have healed.	*Symptoms:* Sudden onset, sore throat, vomiting, rapid rise in temperature. Tongue heavily coated, in few days becomes bright red, swollen, "strawberry tongue." Forehead and neck flushed, region around mouth is usually pale. Pulse is rapid, appetite is poor, bowels constipated, urine scanty. Restlessness, headache, insomnia, delirium, and convulsions may occur during ing disease. *Complications:* Cervical adenitis, otitis media, nephritis, arthritis, rheumatic fever, endocarditis.	Isolation in separate room. Complete bed rest until 24 hours after temperature returns to normal. Tepid sponges may be given to reduce temperature. Addition of sodium bicarbonate to bath water may relieve itching. Olive oil or cocoa butter applied during desquamation period adds to patient's comfort. Never use alcohol during desquamation stage. Give mouth care q4h; throat irrigations or gargles may give relief during sore throat stage. Accurately measure intake and output. Fluids and semisolids during acute stage. *Disinfection:* All articles soiled with discharges from nose, throat, sores, wounds. Incinerate paper handkerchiefs and dressings.
SMALLPOX (Variola) Caused by virus of smallpox	*Source:* Lesions of mucous membranes and skin of infected person. Dried crusts from skin lesions remain infectious for long periods. *Spread:* Direct contact with infected person. Indirectly by articles soiled with discharges from lesions.	*Incubation:* 8–16 days. *Communicable:* From first symptoms to disappearance of all scabs and crusts.	*Symptoms:* Sudden onset, headache, malaise, vomiting, sudden rise in temperature. Severe backache on third or fourth day, macular rash appears on face, forearms, hands, and spreads rapidly over entire body. Rash becomes papular, changes to vesicles, then to pustules, crusts. Face is swollen, lesions appear in mouth and throat, characteristic musty odor is present. Patient is very toxic. *Complications:* Secondary infection, conjunctivitis, laryngitis, septicemia, nephritis.	Isolate in separate room. Wear close-fitting cap in addition to gown. Place cradle over painful portions of patient's body. Tepid sponges and sedatives may relieve restlessness, delirium. Addition of sodium bicarbonate to bath water may relieve itching. Applications of ointments to hands and feet may soften skin to help lessen pain of rash break ing through skin. Do not remove crusts forcibly, allow them to drop off. Mouthwash of penicillin is frequently given when lesions are on mucous membranes. Hot throat irrigations may be helpful. Apply cream about lips and nares. Protect eyes from direct light, apply ointment to lids, eye irrigations may be ordered. Force fluids and semisolids. Feed patient when hands are involved in rash. *Disinfection:* All articles in contact with patient or soiled by discharges. Use special care in handling linen. Incinerate paper handkerchiefs and dressings.

Table V.—CHART OF SELECTED COMMUNICABLE DISEASES—Continued

Disease and causative organism	Source of infection, mode of transmission	Incubation period, communicable period	Common symptoms, possible complications	Points in nursing care
TUBERCULOSIS (Pulmonary) Caused by tubercle bacilli.	*Source:* Persons with "open tuberculosis (sputum, nose and throat discharges contain tubercle bacilli). *Spread:* Direct or indirect contact witb infectious persons; by means of coughing, sneezing, droplets. Infections rarely occur from casual contact but usually from long and close exposure.	*Source:* Variable. *Communicable:* As long as the tubercle bacilli are discbarged by tbe patient.	*Symptoms:* Fatigue without cause, loss of weight, cough of three or more weeks duration which does not respond to treatment. Loss of appetite and digestive disturbance. Night sweats. Afternoon temperature elevation. Tubercle bacilli may be found in sputum and/or gastric washings. Lesion may be found on chest X-ray. *Complications:* Spread, pleurisy with or without effusion, hemorrhage, atelectasis, spontaneous pneumothorax.	Isolation in separate room or ward. Tuberculosis is a long-term disease, tberefore morale is an important factor. Rest in tbe most important part of treatment. Encourage strict observance of a. m. and p. m. rest periods. Teach patient ways to protect bimself and otbers from infection. Daily batbing if condition permits, watch closely for pressure sores on bony prominences. Demonstrate care of sputum, sputum cups. Foods high in vitamin B and C shonld be given, served attractively and at the proper temperature. *Disinfection:* All articles in contact with patient. Incinerate paper handkerchiefs and sputum cnps.
DYSENTERY A. Amebic (amebiasis) Caused by endomoeba bistolytica	*Source:* Feces of infected persons, especially carricrs. *Spread:* Indirectly by foods, articles, water. flies.	*Incubation:* 3 days to several months, commonly 3–4 weeks. *Communicable:* During course of infection and until feces are negative for ameba.	*Symptoms:* Diarrhea and abdominal cramps. Fever, weight loss, general debility, diarrhea, often bloody or watery stools, foul odor to feces. May be alternate constipation and diarrhea. *Complications:* Liver abscess, hepatitis, lung abscess.	Room with screened door and windows. Complete bed rest during acute stage. Teach patient to wash hands after defecation and before handling food. Measure intake and outpnt. Chart description of each stool. During acute stage feed patient frequent small meals high in carbohydrates, after acute stage diet should be high in protein. Avoid fruit juices, leafy vegetables, salads. When emetine hydrochloride is being administered, watch patient for symtoms of visual disturbance, increased pulse rate, fall in blood pressure, pallor or cyanosis. *Disinfection:* All articles in contact with discharges from alimentary tract. Disinfect feces before disposal if municipal sewerage is not available.
B. Bacillary (shigellosis) Caused by various species of shigella	*Source:* Feces of infected persons and carriers. *Spread:* Indirectly by foods, water, articles contaminated by infected person or carrier; also contaminated flies.	*Incubation:* 1–7 days. *Communicable:* During disease and until feces are negative for organisms.	*Symptoms:* Mucus or bloody diarrbea, abdominal cramps, tenesmus, fever, prostration. In severe cases, marked dehydration, abdominal distention, coma. *Complications:* Artbritis, pneumonia.	Room with screened door and windows. Bed rest depends upon the severity of disease. In acute stage, prevent chilling, keep room warm and quiet. Because disease may be of long term duration and be debilitating, daily baths with special attention to bony prominences are important. Devices for comfort should be employed where useful. Special mouth care q3h; force fluids during acute stage, avoid milk. Give frequent small meals, gradually return to normal diet. *Disinfection:* Same as for amebic.
TYPHOID FEVER Caused by typboid bacillus	*Source:* Feces or urine of infected persons and carriers. *Spread:* Direct contact witb patient or carrier indirectly by contaminated water, food, milk, shellfish, flies.	*Incubation:* 3 to 38 days, usually 7–14 days *Communicable:* From first symptoms tbroughout convalescence or until excreta is repeatedly negative for organism.	*Symptoms:* Variable, lasts 4–6 weeks. First week: constant severe headache, irregular pulse, cough, bronchitis, constipation or diarrhea. Epistaxis (nose bleed), fever higher each p. m. until it reaches 104°–105° F. Second week: Fever remains high, heavily coated tongue, sores, rose spots on abdomen, pulse slow in proportion to temperature, dullness, lethargy, low muttering delirium, eyes open and staring. Third week: Gradual decline in temperature, beginning of convalescence. Convalescence is long, may be 2 weeks to several months. *Complications:* Intestinal hemorrhage may occur in second or third week. Perforation of intestine may occur late in disease. Phlebitis, hroncbitis, pneumonia, cholecystitis.	Isolate in room with screened door and windows. Plan care to provide maximum rest for patient. During period of high fever take reotal temperatures, give tepid sponges, ice cap to head, mouth care q3h. Watcb bony prominences closely for pressure areas, avoid pressure on abdomen when bathing patient. Stay with patient during delirium. Allow patient to chew gum if he is able. If constipation is present, enemas may be ordered, give very slowly. Cathartics are not given because of danger of perforating intestines. Diet—high calorie, high carbohydrate in frequent small meals. Force fluids. Patient may be fed because of lethargy and poor appetite. *Disinfection:* All articles in contact with patient. Disinfect excreta before disposal when municipal sewerage is not available. Incinerate all burnable materials.

Table V.—CHART OF SELECTED COMMUNICABLE DISEASES—Continued

Disease and causative organism	Source of infection, mode of transmission	Incubation period, communicable period	Common symptoms, possible complications	Points in nursing care
MALARIA Caused by protozoan parasite (four types). Plasmodium vivax Plasmodium falciparum Plasmodium ovale Plasmodium malariae	*Source:* The blood of infected person. *Spread:* By bite of infected anopheline mosquitoes.	*Incubation:* Varies with species of infecting organism and the number infected. *Communicable:* As long as sexual form of organism exists in blood in sufficient quantities to infect anopheline mosquitoes.	*Symptoms:* Shaking chills, periodic fever, headache, malaise, skin hot and flushed during chills and high fever. After chills, profuse diaphoresis, extreme thirst, delirium, spiking temperature, backache. *Complications:* Anemia, hemoglobinuria, frequent relapses.	Room with screened door and windows. If not available, place netting over bed. Bed rest during paroxysms of chills and fever. Cold stage: apply blankets, hot water bottles, urge hot drinks. As hot stage develops (immediately after cold stage) gradually remove heat. Tepid sponges and ice cap to head may help during this stage. Force cold fluids. Place small pillow under small of back to relieve ache. If delirious, apply sidebars to bed as safety measure. Sweating stage follows hot stage, temperature drops rapidly, profuse diaphoresis. Force fluids, change linen frequently, keep dry, avoid drafts to prevent chilling patient. Three stages may last 6–10 hours. Observe and record time, severity and duration of each stage.
DENGUE Virus of dengue fever	*Source:* Blood of infected persons one day before and up to 5 days after onset. *Spread:* By bite of mosquito, infected by biting a patient during the above period. The mosquito becomes infectious after an interval of 8–11 days.	*Incubation:* 3–15 days. *Communicable:* From day before onset until the fifth day of disease.	*Symptoms:* Sudden onset, high fever, intense headache, joint and muscle pains, irregular eruption. Intense pain in eyes may be a complaint. *Complications:* Rare, asthma, peripheral neuritis.	Room with screened door and windows for 5 days. Bed rest during fever period. Ice cap to head. Cradle to keep top covers off painful joints. Calamine lotion to relieve itching. Protect eyes from direct or strong light. Cold compresses to eyes may be soothing. Urge patient to keep eyes closed as much as possible. *Disinfection:* As for general hospital patient.
PLAGUE Caused by plague bacillus *Types:* Pneumonic Bubonic	*Source:* Infected rodents and patients. *Spread:* Direct by droplet, nose and throat discharges in pneumonic form. Bubonic transmitted from rodent to man by bite of flea.	*Incubation:* 3–6 days. *Communicable:* Pneumonic during active stage. Bubonic—not communicable from man to man.	*Symptoms:* Pneumonic forms: Bronchopneumonia develops rapidly, sputum bloodstreaked and watery. This form is usually fatal in short time. *Bubonic forms:* Sudden onset; headache, vomiting, prostration. Delirium, conjunctiva injected, facial expression of weariness characteristic. Tongue furred and swollen, subcutaneous hemmorrhages giving rise to term "Black Death." Lymph glands become swollen, painful, and may suppurate, especially those of the neck, groin, and axilla. *Complications:* High mortality rate, secondary pneumonia, and pleurisy.	Isolation in room with screened windows. *In pneumonic type:* Worker wears close fitting hood, goggles, coveralls, rubber gloves. Nursing care that of pneumonia. *Bubonic Type*—nursing care is that of typhoid fever. The patient is very ill and needs constant care. *Disinfection:* In pneumonic type—all sputum, tissues, contaminated with mouth and nose secretions must be burned. In bubonic type, burn all dressings and bandages. Both types: all contaminated equipment must be disinfected. Area of original infection should be treated to destroy rats and fleas. *Terminal disinfection:* Clean walls, floors, etc. with 5 percent solution compound cresol. Air room for 48 hours.
TYPHUS FEVER Caused by rickettsia prowazeki A. Epidemic B. Endemic	*Source:* A. Epidemic type, infected persons. B. Endemic type, infected rats. *Spread:* A. Epidemic type. Bite of infected louse, or feces of infected louse inoculated into bite or wound. B. Endemic type, bite of fected flea.	*Incubation:* 6–15 days. *Communicable:* Not from man to man. Patient is infective to lice during fever and possibly 2–3 days after temperature is normal.	*Symptoms:* High fever, chills, severe headache, severe back and generalized body aches and pains. Rash about fifth day covering trunk but avoids hands, feet, face. Cough, bronchitis. Pulse slower than fever would indicate. May become stuporous, delirious. *Complications:* Bronchitis, bronchopneumonia, otitis media, mastoiditis.	Place in room or ward *after* all lice and nits have been removed from his person. Patient and bedding should be dusted with DDT once a week during febrile period. Force fluids during period of high fever. Care is similar to that of typhoid fever. *Disinfection:* As for a general hospital patient. Handle linen carefully.

THE CARE OF THE PATIENT ON THE SURGICAL SERVICE

Review, Chapter III, "Shock," "Inflammation," "Hemorrhage," "Wounds," "Emergency Medical Care"

Patients on the surgical service are those who have had or are to have operations. Their care will be basic patient care plus surgical aseptic techniques and the therapeutic nursing procedures required by their local condition.

Preoperative Care

The success of an operation depends to a large extent upon the preoperative condition and preparation of the patient.

The corpsman is responsible for the physical preparation of the patient according to the doctor's order. The mental preparation of the patient, while not a written order, is just as important to the patient and to the success of the operation. The corpsman should keep in mind that regardless of how the operation is recorded in the records (i. e., major or minor) it is always a serious major operation to the patient.

The patient's fear of the operation itself; of not knowing what to expect; of being at the mercy of others without a chance of defending himself, or of not knowing what the outcome will be, have considerable bearing on his disposition toward the operation. The corpsman through his close association with the patient is able to lessen his fears by explaining and performing his tasks in a confident manner, by observing and reporting to the doctor when more technical and professional advice is indicated.

When a patient is scheduled for operation, the corpsman should routinely notify the chaplain of the patient's faith. The chaplain will be able to give the patient advice and guidance in family or religious matters.

Usually the patient will be in the hospital several days or weeks prior to the operation. He will have a complete physical examination, numerous laboratory tests, medications, and treatments ordered to bring him to the best physical condition for operation. During this period he will have time to think and ponder over the possible result of the operation. Confidence in all personnel, explanation and assurance by the doctor of his ultimate recovery, will help in having the patient in mental readiness for the operation.

A signed permission must be obtained for all patients (other than service personnel) before the operation.

Skin Preparation Procedure

Definition: Skin preparation consists of cleansing and shaving an area sufficiently large to provide ample field for operation.

Purpose: To make operative field as clean as possible.

Time and place: Evening before surgery—either in surgery or on ward.

Equipment

Safety razor with new blade.
Green soap and warm water.
Clean gauze sponges or flats.
Curved basin.
Rubber sheet with cover.
Applicators.
Spot light.

Procedure

Wash your hands!! Refer to chart for proper area to be prepared for operation (fig. 315–316).

1. Explain the procedure to the patient.
2. Screen patient to provide privacy.
3. Place covered rubber sheet under area to be prepared.
4. Place light at best angle to see hairs.
5. Moisten gauze, lather small area at one time.
6. Shave in direction of hair growth. Avoid scratching the skin with razor.
7. Clean umbilicus with moistened applicators if an abdominal preparation.
8. Inspect lumbar area, shave area if hair is visible for patient having spinal anesthesia.
9. Have patient take a shower or tub bath after shaving is completed.

Orthopedic Skin Preparation

First preparation—48 hours before operation.

Equipment

Shaving tray plus sterile gauze flats.
Sterile forceps in disinfectant solution.
Orangewood stick for finger and toe nails.

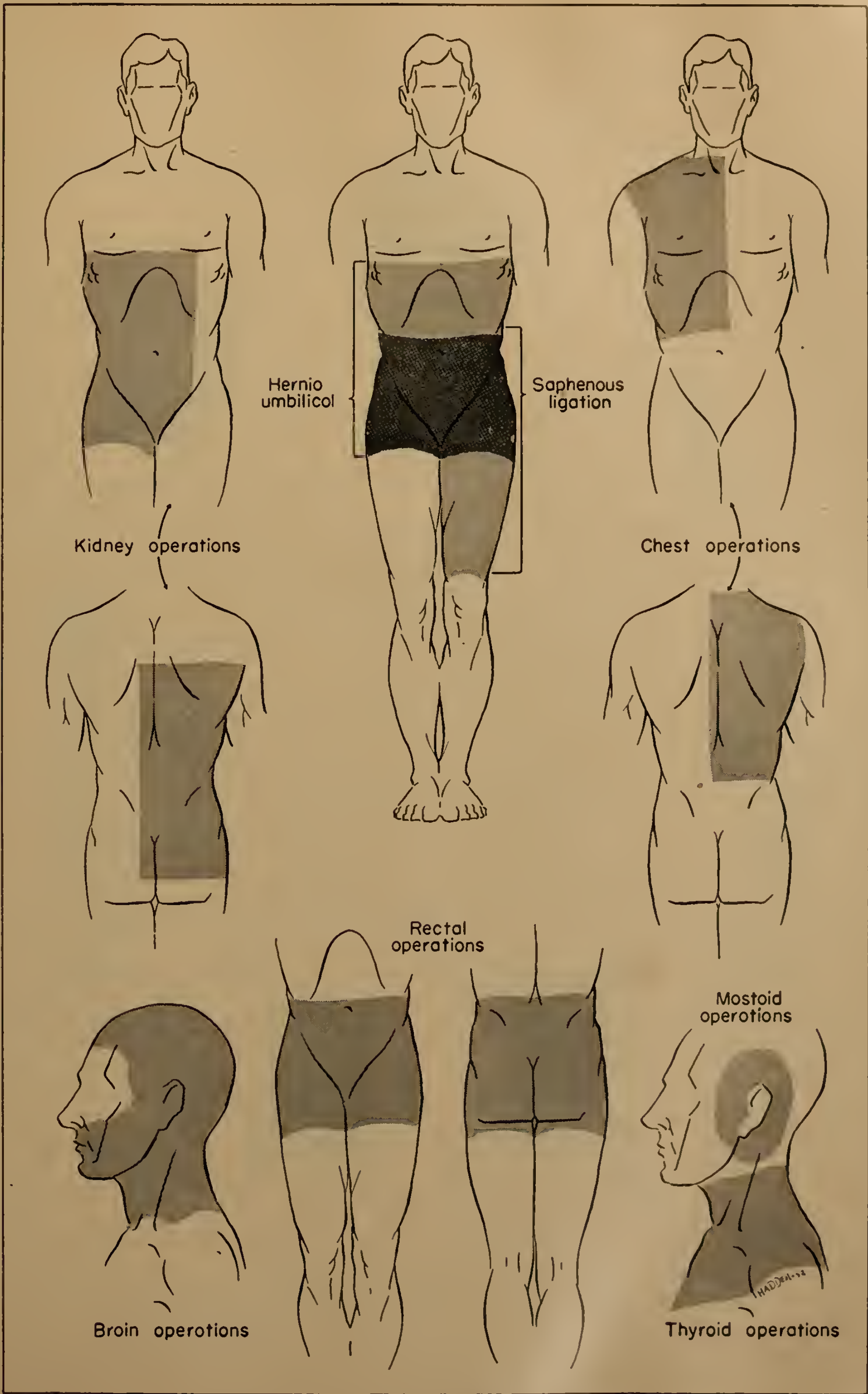

Figure 315.—Areas of Skin Preparation for Operation.

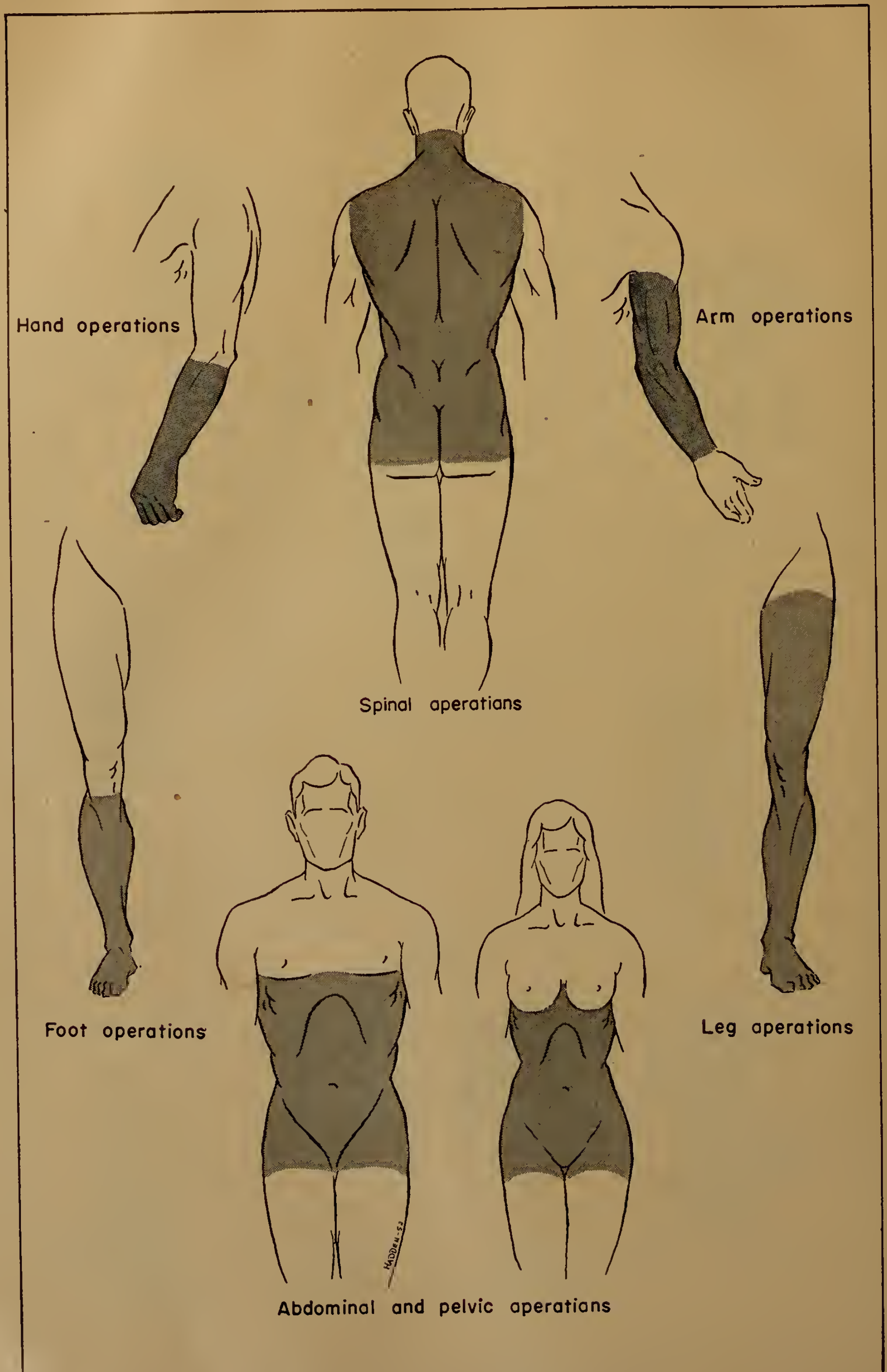

Figure 316.—Areas of Skin Preparation for Operation.

Nail brush.
Sterile towels.
Bandage, tape.
Green soap, alcohol, ether.

Procedure

1. Shave area as described on chart. Use orangewood stick and brush for finger and toe nails (fig. 316).

2. After area is shaved:

Pick up gauze flats with forceps, pour green soap on gauze.

Clean area, starting at one point and continuing until entire area is covered. Do not go back over any area twice. Repeat with alcohol. Repeat with ether.

Wrap area with sterile towels, keeping inside of towel sterile.

Secure towels with bandage, adhesive tape around bandage.

3. Twenty-four hours prior to operation:

Repeat entire procedure. Doctor may order painting of the area with an antiseptic. If so, allow area to dry thoroughly before wrapping in sterile towel.

Immediate Preoperative Preparation of the Patient (24 Hours Before)

Modification of this routine will be made due to variety of operations, anesthetics, and preferences of doctors. Check doctor's orders!

Day before surgery

1. Urge patient to take frequent rest periods, to drink plenty of water.
2. Check laboratory work, see that all reports are on chart. Check to see if operative permit has been obtained.
3. Light supper.
4. Cleansing enema.
5. Skin preparation of operative site.
6. Complete bed or tub bath or shower.
7. Hypnotic if ordered.

Day of surgery

1. Nothing by mouth.
2. Early a. m. care.
3. Take temperature and blood pressure; note record and report any signs of a cold (sore throat, sniffles, elevated temperature, cough, expectoration).

4. Remove jewelry—wedding band may be retained by patient and secured by a bandage passed through the ring and tied at the wrist.
5. Remove prosthesis:

Place teeth in cup; place eye in drawer of bedside locker.

Place leg in clothes locker (properly tagged).

6. Female patients—remove bobby pins, combs from hair. Wrap hand towel around head, secure in front of head with pin. Remove lipstick, nail polish (anesthetists watch lips and nails for signs of cyanosis).
7. Reverse pajama coat, omit pants.
8. Have patient void one-half hour before going to operating room. If patient is unable to void, notify doctor who may order catheterization.
9. Prepare prescribed preoperative hypodermic, give as patient leaves for operating room unless a specified time has been ordered.
10. Place patient on stretcher—cover carefully. The amount of covering will depend upon the distance the patient will have to travel to the operating room, the climate, and the condition of the patient.
11. Send patient's chart, X-rays (if required) with patient.

While patient is in operating room

1. Provide for ventilation of bedside unit, prevent drafts by placing screen in front of open window.
2. Prepare recovery bed and top of bedside locker (see bedmaking).
3. Move furniture to provide sufficient room for stretcher and other apparatus.
4. Obtain other equipment.

Shock blocks.

Bottle, tubing, connecting tip if there is a possibility of drainage from operative site.

5. Have intravenous infusion set-up, Wangensteen apparatus, or other apparatus that may be needed, in readiness.

Postoperative Care

Immediate

1. Remove hot water bottles from bed if present.
2. Roll back top bedding.
3. Assist with lifting patient from stretcher (three-man or draw-sheet carry).

4. Place in position (according to doctor's orders).

General anesthesia.—Patient flat in bed without pillow, head turned to one side.

Spinal anesthesia.—Patient flat in bed or in shock position.

Local anesthesia.—Patient may have head of bed elevated.

5. From anesthetist:

Find out type and nature of anesthesia and operation.

Immediate postoperative orders—presence of drainage tubing.

Locate and inspect dressing. Inspect frequently thereafter.

6. Care:

Take pulse, respiration, blood pressure at once and every 15 minutes until patient has reacted. Pulse will usually be 10 to 20 beats above normal until recovery. Respirations will be 18 to 24; watch for snorting, noisy respirations, dusky hue to skin (patient may be swallowing tongue). Hold jaw up and forward (fig. 317a), hold tongue with tongue depressor. Remain with patient until he is conscious. (If patient has an airway, remove it as he begins to respond. Figure 317b illustrates the curve of the airway; when removing follow same arc to avoid injuring patient's throat.)

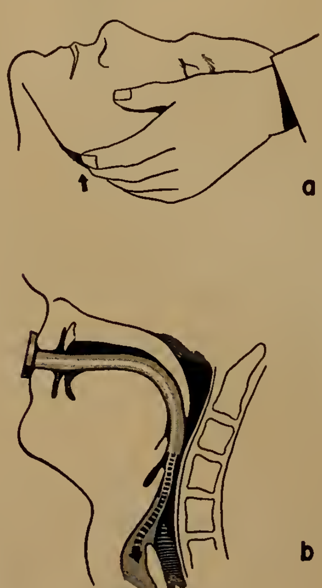

Figure 317.—(a) Holding Jaw. (b) Airway in Place.

Connect drainage tubing if present.

Inspect dressing frequently for signs of bleeding.

When patient reacts

1. Remove excess covering.
2. If patient is groggy, place side bars on bed as safety precaution.
3. Check working order of apparatus.
4. If in pain give prescribed medication. Start sips of water by mouth if ordered and no nausea is present.
5. Watch voidings. If patient does not void 8 hours after last voiding, try measures to induce him to void. If patient is unable to void, notify doctor.
6. Urge patient to take deep breaths every hour.
7. Nausea and vomiting due to anesthesia should not last longer than 4 to 5 hours. If it does it may be due to idiosyncrasy to drug or complications; report to doctor.

Later care

1. Give basic nursing care plus medications and/or treatments ordered.
2. Watch for signs of postoperative discomfort and complications.
3. Encourage patient to help himself as much as possible. The patient may be permitted out of bed the day of operation or soon after. This general practice has shortened the length of hospital stay and hastened return to complete health.

POSTOPERATIVE DISCOMFORTS [26]

Headache

Causes

1. Effect of anesthesia.
2. Nervousness.
3. Fatigue.
4. Confusion.
5. Excitement.
6. Poorly ventilated room.

Treatment

Quiet, rest, fresh air, ice cap to head, hot water bottle to feet, medications if very severe.

[26] Adapted from Handbook of Hospital Corps—1949 edition.

Backache

Causes

1. Uncomfortable position on operating room table.
2. Undue strain during surgery.
3. Lying in one position too long.

Treatment

1. Careful lifting of patient.
2. Frequent change of position. Urge patient to move about in bed.
3. Alcohol back rubs (remove binders during back rub).
4. Pillows for support—at back, between knees, under abdomen.

Thirst

Causes

1. Dehydration.
2. Preoperative hypodermic.
3. Anesthetic.
4. Profuse perspiration.

Treatment

1. Water by mouth, if allowed.
2. Moisten lips with sponge dipped in cold water.
3. Mouth wash.
4. Chewing gum.

Nausea and Vomiting

Causes

May be due to anesthetic or idiosyncrasy to drug.

Treatment

1. Deep breathing exercises to eliminate anesthetic as soon as possible.
2. Hypnotic or narcotic to rest patient, if necessary.
3. Wangensteen suction drainage if ordered.

Restlessness and Sleeplessness

Causes

Any of the above discomforts; pain, worry, reaction, etc.

Treatment

Above treatments, reassure patient, help him relax by alcohol back rub, straightening bed, shaking up pillows, morphine, or a barbiturate as ordered.

Pain

Causes

1. Wearing off of anesthetic.
2. Trauma from manipulations or manual procedure during the operation.

Treatment

1. Change position if allowed.
2. Use abdominal binder and pillows for support.
3. Prevent coughing or vomiting as much as possible.
4. Administer hypnotic if ordered.

Abdominal Distention With Accompanying Gas Pain

Causes

1. Shock from operation.
2. Taut muscles.
3. Remaining in one position too long.
4. Sluggish peristalsis.

Treatment

1. Frequent change of position. Urge patient to move around in bed.
2. Insert rectal tube if not contraindicated. (Insert about 3 inches with the other end of tube in a urinal to prevent chance of soiling bed.)
3. Hot water bottle to the abdomen if ordered.

Hiccough (Singultus)

Treatment

1. Have patient breathe into paper bag held close to his face so that bag inflates and deflates with each respiration.
2. If fluids are permitted—have patient take several large swallows of water while holding his breath. If these measures do not stop hiccoughs report to doctor.

POSTOPERATIVE COMPLICATIONS

Pneumonia

Causes

1. Infection carried to lungs from infected area of operation.
2. Aspiration of vomitus.

3. Irritation of lungs by anesthetic.
4. Patient becoming chilled.
5. Patient lying in one position too long.
6. Result of a cold which patient, other patients, or personnel might have had.

Symptoms

1. Elevated temperature, increased pulse rate and some difficulty in respiration.
2. Productive cough.
3. Pain in chest.
4. Symptoms usually appear on third day.

Preventive measures

All those listed under Treatment of Discomforts.

Treatment

As ordered by doctor.

Other complications

Among other complications which may arise following a surgical operation are: intestinal obstruction, peritonitis, tympanites, suppression of urine, retention of urine, infection, thrombophlebitis, or an embolus. These complications will be noted by the medical officers and appropriate treatment will be ordered for their relief.

Peritonitis

Symptoms

1. Increase in temperature, pulse, and respiration.
2. Patient appears toxic (general poisoning of blood due to absorption of bacterial products).
3. Sudden onset of abdominal pain.
4. Tender, rigid, board-like abdomen with distention.

Treatment

1. Fowler's position—to localize inflammation.
2. If wound is draining, frequent change of dressings.
3. Insertion of rectal tube if ordered.

Tympanites

Paralysis of the peristalsis, with distention of the abdomen, due to gas and feces (alertness and good nursing may prevent this condition). Watch for signs of distention, and begin treatment before serious trouble begins.

Symptoms

1. Abdominal pain and discomfort.
2. Abdominal distention.
3. Respiratory difficulty.
4. Increased pulse and respiration rate.

Treatment

1. Urge patient to move about in bed.
2. Change patient's position frequently.
3. Insertion of rectal tube if ordered.

Suppression of Urine (Failure of Kidneys to Function)

Symptoms

1. At first urine is scanty.
2. Headache, dizziness, impaired vision, nausea, restlessness.
3. Puffiness under the eyes.
4. Later urine is entirely absent; odor of ammonia to breath.
5. Patient becomes delirious, drowsy, has muscular spasm.
6. Patient has convulsions, coma, and death—unless he responds to treatment.

Retention of Urine (Inability to Void)

Methods to induce urination

1. Give warm drinks or small amounts of hot water.
2. Let patient hear the sound of running water.
3. Let patient immerse hands in warm water.
4. Hot water bottle over bladder area.
5. Enema or Sitz bath—only on order from doctor.
6. Allow to sit or stand on side of bed—requires doctor's order.

Infection

Causes

1. May be due to conditions existing before operation.
2. May be due to bacteria introduced into wound during or following operation—may be local or general.

Symptoms

1. Sharp rise in TPR.
2. Abdominal pain or discomfort in area of operation.
3. Abdomen may be distended.
4. Drainage from incision.

Intestinal Obstruction

Symptoms

1. Abdominal distention.
2. Frequent vomiting in small amounts.
3. Sharp colicky abdominal pain with intervals of no pain.
4. Hiccoughs.

Treatment

1. Frequent change of position.
2. Wangensteen, if ordered.
3. May require surgical intervention.

Thrombophlebitis

Symptoms

1. Cramp-like pain, and/or swelling of the limb.
2. A lump may or may not be felt under the skin in painful area.

Treatment

1. Do not rub, massage, or bathe limb.
2. Elevate limb on pillow—keep the patient and the limb at ease.
3. Immobilize the limb with sandbags or pillows.
4. Application of heat—dry or moist as ordered.

Embolus

Symptoms

1. Sudden onset, collapse.
2. Pain in chest.
3. Acute sudden respiratory distress.

Treatment

1. Complete bed rest—Fowler's position.
2. Oxygen therapy.

THE CARE OF THE PATIENT ON THE ORTHOPEDIC SERVICE

Review—Chapter II, "The Skeletal System"
"The Muscles"
Unit II, "Basic Nursing Care"

Patients on the orthopedic service are those who require treatment of fractures, deformities and diseases of the musculo-skeletal system. Some patients require surgery and immobilization to correct their conditions, others require immobilization, bed rest and re-education.

The usual orthopedic patient is in good general physical condition and is a bed patient only because the treatment prescribed for his local condition limits his movements. This patient usually is a long-term patient, his hosiptal stay may extend over many months.

The care of the orthopedic patient may be considered as being in two stages:

1. The period of immobilization—when the patient is in a cast, traction, frame or brace. Sound basic nursing care at this time is most important.
2. The period of rehabilitation—when the patient re-learns how to use his muscles under the direction of the physical medicine department. Cooperation of the nursing personnel with the physical medicine department is most important at this time.

What the Corpsman Should Know

1. How to take care of the patient with the appliances used for his treatment.
2. How the patient's orthopedic condition limits his movements.
3. The amount and type of activity the patient is permitted.
4. The amount and type of treatment the patient is receiving in other departments.

THE PATIENT IN A CAST

Casts may be applied to extremities to immobilize one or more joints. *Example:* below knee cast to immobilize ankle joint; above knee cast to immobilize ankle and knee joints. Casts may be applied to the body to immobilize lower trunk and one or both legs; to immobilize head and upper trunk or to immobilize trunk only.

Assisting with application of plaster casts

Equipment

Examining table.
Buckets of tepid water.

Large bandage scissors.

Rolls of plaster bandage of desired width, according to doctor's preference.

Stockinet or sheet wadding.

Felt padding.

Newspaper.

Procedure

Preparation of patient and unit:

1. Explain the procedure to the patient.
2. Cleanse and thoroughly dry the part to be encased.
3. Spread newspaper on floor under and around table.
4. Place the patient in position desired by doctor.

Preparation of plaster:

1. Remove paper wrapper from roll.
2. Place roll on end in bucket. Allow roll to remain undisturbed in water until bubbles stop rising.
3. Grasp both ends of roll, lift from water and slowly squeeze until water stops dripping from roll. Do not twist roll.
4. Prepare rolls so that two or three are soaking while one roll is being applied.
5. Change water in buckets after every six to eight rolls. (When water is too heavily saturated with plaster the rolls do not soak properly.)
6. Method of application

   Part to be encased is covered by stockinet or sheet wadding.

   Felt pads are cut to fit bony prominences.

   Doctor applies plaster rolls while corpsman holds part in desired position.

   The patient remains on the table until cast is set.

Immediate care—First 24 hours:

1. Prepare the bed for the patient.

   Place fracture board under mattress.

   Place rubber covers on pillows to be used to support cast.
2. Lift patient carefully from stretcher to bed.

   Do not roll patient.
3. Use the palms of hands when lifting a damp cast. Avoid using fingers—fingers cause depressions in cast which in turn cause pressure areas.
4. Place the encased part on rubber covered pillows. Support the cast its entire length.

   Cast on extremity—support on inclined plane.

   Cast on body—use enough pillows to support the entire body.
5. If cast is on an extremity—leave it exposed. If cast is on the body, screen patient, cover the pubes and leave cast exposed **after** patient has completely recovered from anesthetic or shock.
6. Watch patient closely.

   If patient has had surgery—treat as a postoperative patient. Be alert for signs of shock or hemorrhage.

   All patients—report any complaint of pain or pressure at once—do not wait!

Cast on extremity

Inspect fingers or toes of the encased extremity frequently for pallor, blueness, swelling, or coldness. Does the skin show a slow return to pink where you press it with your fingers?

Take the pulse of exposed fingers or toes of the encased extremity.

Does the patient complain of a burning sensation? Does the patient complain of tingling, pressure, pain? What is the location of complaint?

Cast on body

Is the cast pressing anywhere: on chest, groin, buttocks, or knee?

Does the patient have difficulty breathing?

7. Quick drying or baking should not be attempted without a doctor's order and until after the cast is set. (Cast may dry on the outside and patient may be burned by the moist heat generated inside the cast.) A cast may take from several hours to 2 to 3 days to dry completely.

Later care

1. Patient with cast on arm or leg:

   Turn patient every 2 hours to allow all parts of the cast to dry.
2. Patient with body or spica cast:

   Turn the patient for the first time 6 to 8 hours after application of the cast, then every 2 hours.

   To turn the patient: Slide the patient on the pillows to the side of the bed. (Spica—always turn with operated hip uppermost.)

   Place rubber-covered pillows along the length of the cast.

   Ask the patient to raise his arms above his head.

   With help and at signal turn the patient over on his abdomen onto the pillows.

Fold a pillow and place it under the feet to relieve pressure of toes on the bed (in spica cast, one foot should be off the mattress when patient is on his abdomen).

Protect the cast about the buttocks and perineal area with oiled or plastic material.

Check condition of patient's skin under the cast frequently.

Be alert for possible pressure sores.

Reach under cast while patient is on his abdomen and wash his buttocks and back; rub well with alcohol.

Smell the cast frequently for moldy, putrid, or other abnormal odors. Pressure areas may often be first detected by odor.

Check supports; is the patient's entire body supported on the same plane as the encased parts?

Check elimination: abdominal distention and constipation are fairly common complications for the first week after a body cast is applied.

3. Smooth rough edges of cast after it is completely dry:

Pull out stockinet lining and tape it to the ouside of the cast, or petal edges:

Cut 2-inch adhesive in 12-inch strips.

Fold tape lengthwise, cloth sides together.

Cut 2-inch pieces at 45° angles.

Open petal, place single point outside cast, double point inside cast. Overlap petals about entire edge of cast.

4. Watch for signs of cast cracking.

5. Encourage the patient to exercise as much as possible in preparation for crutch walking. These bed exercises may be in the form of lifting dumbbells, doing "pull ups" on the balkan frame trapeze, or "push ups" on bed.

To remove a cast

1. Transfer the patient to a stretcher or table if possible.
2. Place newspapers or rubber sheet under the cast.
3. Moisten cast along the cutting line with hydrogen peroxide or vinegar (apply solution with a medicine dropper or bulb syringe).
4. Cut cast.
5. Remove top half of cast, return patient to his bed.
6. Lift limb out of cast, place limb on pillows, supporting its entire length.

After cast is removed

1. Remove all plaster crumbs from bed.
2. The limb will probably be covered with a yellow crust and be odorous. Avoid attempting to remove this crust by vigorous scrubbing or rubbing, it is a protection for the skin. Gently wash the limb with a mild soap and water. If a new cast is not to be applied, cocoa butter or a similar substance may be used to soften this exudate.
3. The patient may complain of soreness and discomfort in the limb for several days after the cast is removed. This is because the muscles of the limb are weak and have lost the support of the cast.
4. The cast shell may be used to support the limb at night. If so, smooth rough edges of cast, replace lining, clean cast. Montgomery straps may be used to hold the cast in place.

THE PATIENT IN TRACTION

Types of traction

Skeletal—traction is applied directly to the bone by tongs, pin, or wire connected to weights and pulleys.

Skin traction is applied to the skin by the use of heavy adhesive tape connected to weights and pulleys.

Preparation of patient and his unit

1. Place the patient in a bed having a fracture board under the mattress and a balkan frame overhead.
2. Check with the doctor as to the type of splint, frame, attachments, and traction he will use. If skeletal traction is to be used, the area is prepared as for a surgical operation. If skin traction is to be used the area should be shaved. Tincture of benzoin may be applied to protect the skin and improve the sticking qualities of the adhesive.
3. Bring the orthopedic cart and other necessary equipment to the bedside.
4. Assist the doctor as required.

After traction is applied

1. The angle of traction must be maintained. Shock blocks under the head or foot of the bed may be used to keep the patient in position.

Figure 318.—Patient in Traction.

2. The weight of traction must be maintained. Check weights frequently. Are the weights hanging free? Are the ropes in the pulley groove?

3. Traction on arm or leg:

Is the hand or foot supported? The foot should be at a right angle to the leg, hand should be supported in a functional and correct anatomical alignment.

Check adhesive in skin traction. Is it slipping? Is it wrinkled? Check the pins or wires and condition of the skin in skeletal traction. Are the pins resting on the splint? Are the ends of the wire covered by corks or adhesive?

Support the free foot by a footboard.

4. The patient should be comfortable once the traction is applied. If he is not, something is wrong. Recheck items listed in this section and refer to the "Check list relating to the comfort of the patient" for additional possible causes of his discomfort.

5. Encourage patient to do bed exercises in preparation for crutch walking.

Crutch Walking

Types of crutches

Aluminum cane type—has mid-forearm supports. Height is adjusted in shaft of crutch.

Wooden type—has axillae and hand bars. Height is adjusted in shaft and hand bars of crutch.

Measurement of crutches

Aluminum cane type: Have patient stand against a wall; adjust height of crutch so that when patient leans on crutch his elbows are in 30° flexion, hands are flat on hand bars, and crutch is 4 inches out from the side of his heel.

Wooden type: Have patient lie flat in bed, hands at sides; using a tape measure, measure from the border of the axilla to 6 inches out from the side of his heel; adjust height of crutch to this measurement; place crutch in same position you had tape measure; ask patient to place his arm over the crutch and grasp hand bar so that patient's elbows are in 30° flexion and the palm of hand is flat on hand bar.

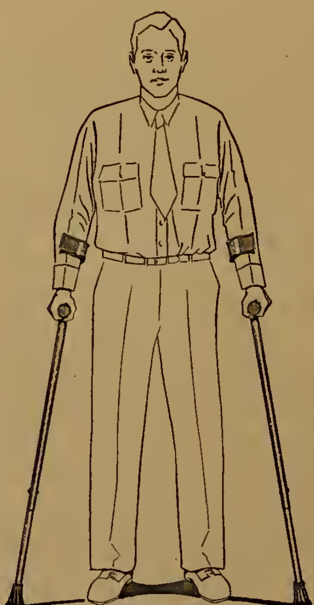

Figure 319.—Aluminum Cane Type Adjustable Crutch.

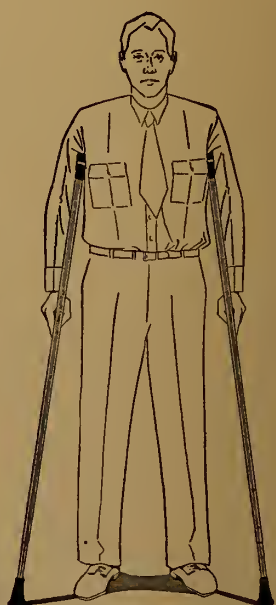

Figure 320.—Wooden Adjustable Crutch.

Teaching the patient to use crutches:

The type of crutch-walking the patient is to use will be ordered and demonstrated by the doctor. It will depend upon whether or not the patient is permitted to bear weight on the injured leg, and whether crutches will be used temporarily or over a long period of time. Whenever possible, crutch-walking should be taught by the physical medicine department.

1. The most common type of crutch-walking for short-term use is the "swing through" gait. The patient bears weight on his good leg, places the crutches at an equal distance ahead of him and then swings to a position just ahead of the crutches. Weight is shifted to the hands and then back to the good leg.

2. Allow patient to practice bearing his weight on the palms of his hands while standing at the side of the bed.

3. Stand in back of the patient when he is learning to use crutches. If he begins to fall, bring him back against your body for support.

Caution patient

1. To wear shoes when crutch-walking.

2. To try to establish a rhythm, take small steps and to look straight ahead when walking.

3. To place crutches ahead and to the side of his body to provide a broad base of support.

4. To bear weight on palms of hands, not on the arm rests. (Paralysis of the radial nerve may result if weight is borne on the axillae.)

5. To avoid wet, slippery or highly waxed floors.

6. To use the crutches for short periods of time and for short distances until he is accustomed to them and does not become tired.

SUGGESTED ADDITIONAL READING—UNIT IV

The Control of Communicable Diseases in Man. 7th ed. New York: The American Public Health Association, 1950.

ELIASON, ELDRIDGE, FERGUSON, L. KREER, and SHOLTES, LILLIAN. *Surgical Nursing.* 9th ed. Philadelphia: J. B. Lippincott Co., 1950.

FUNSTEN, R. V., and CALDERWOOD, CORMELITA. *Orthopedic Nursing*, 2d ed. St. Louis: C. V. Mosby Co., 1951.

JENSEN, JULIUS, and JENSEN, DEBROAH MACLURG. *Nursing in Clinical Medicine.* 3d ed. New York: Macmillan Co., 1949.

MCCULLOCH, ERNEST C. *Disinfection and Sterilization*, 3d ed. Philadelphia: Lee and Febiger, 1948.

MONTAG, MILDRED, and FILSON, MARGARET. *Nursing Arts.* Philadelphia: W. B. Saunders Co., 1948. pp. 74–94; 338–408.

Safer Ways in Nursing. New York: Prepared by Joint Tuberculosis Nursing Advisory Service of the National Tuberculosis Association and the National League of Nursing Education, 1948.

WOLF, LULU K. *Nursing.* D. Appleton-Century Co., Inc., 1947. pp. 308–325.

YOUNG, HELEN, LEE, ELEANOR and Associates. *Essentials of Nursing.* 2d ed. rev. New York: G. P. Putnam's Sons, 1948. pp. 439–498.

Read the current issues of periodicals for the latest information on the care and treatment of your patient.

Periodicals available at most stations: Armed Forces Medical Technicians Bulletin and Journal of Nursing.

WARD MANAGEMENT—UNIT V

Review, Manual of Medical Department, Chapters 11 and 22; Local Station Orders

A ward is a unit of a hospital composed of a number of beds and other equipment necessary to provide service to and for the patients assigned to it.

Ward management is the direction, guidance, and supervision of ward personnel and their activities toward the goal of giving the best possible care to the greatest number of patients.

The management of a hospital ward is ordinarily the delegated responsibility of a nurse corps officer. In executing her responsibilities as ward manager, the nurse corps officer:

1. Defines and assigns duties to the corpsmen and patients by means of detail lists.

2. Establishes routines and schedules for ward activities.

3. Keeps records and reports as required by the Manual of the Medical Department and local hospital orders.

4. Maintains adequate supplies and equipment on the ward.

In a sick bay aboard ship or in the absence of a nurse corps officer, the responsibility for ward management is delegated to the senior hospital corpsman present. The management of a sick bay follows the same general pattern as that of a ward.

Detail list.—A corpsman's detail list is made out and posted on the bulletin board. The list should:

1. Be clear, concise, and complete.
2. List all ward activities (patient care, housekeeping, errands, relief, etc).
3. Divide the activities into evenly distributed work loads equal to the number of corpsmen assigned to the ward.
4. Assign each corpsman according to his ability and experience.
5. Rotate assignments so that each corpsman will gain experience in all phases of patient care available on the ward.

Orientation of a new corpsman to the ward

1. Introduce him to his fellow workers.
2. Take him around the ward; introduce him to the patients and show him where supplies and equipment are stored.
3. Find out what experience he has had, what experience he lacks.
4. Discuss the ward routines, detail lists, and assignments with him.
5. Supervise his work closely until he demonstrates his ability to carry out assigned duties dependably.

WARD ROUTINES AND SCHEDULES

Each ward will necessarily have to adopt routines and schedules according to the type of patients assigned to it. It is recommended that the routine for medications and treatments as outlined be adopted and adapted to all situations where practicable.

Sample routine of the ward during the day[27]

0700–0800 Serve breakfast.
Turn off unnecessary lights.
Make out necessary ward records (person in charge of ward).
Prepare all records, reports for doctor's signature at sick call.

0800 Start morning care to patients, such as baths, treatments, and medications.
Start patients' cleaning details. Begin in doctor's office, examining room, etc., and work toward ward proper.

0900 Morning sick call by ward medical officer, nurse corps officer, senior hospital corpsman. Carry out "stat" orders. Other corpsmen carry on assigned duties.

1100 Weather permitting, ventilate ward; protect patients from drafts.

1130–1230 Serve dinner. Ward corpsmen go to dinner. One-half of crew goes each period.

1300–1400 Rest hour for patients. Check charts, orders, and make out specimen requests. Write ward report book.

1400–1600 Visiting hours. Carry out necessary nursing care of patients.

1630–1700 Serve supper.

1800 Evening care to bed patients.

1900 Evening sick call—Officer of the day, nurse corps officer, and senior corpsman. Carry out "stat" orders.

2000 Distribute specimen containers; start settling ward for the night.
Distribute bedpans and urinals to bed patients as needed.
Distribute extra blankets.
Adjust windows for ventilation.
Turn out overhead lights; turn on night lights.
Check patients for any last minute needs.

2045 Check and see that head, shower, linen, utility and ward galley are clean and in order.

2100 Give report and special orders to relieving night corpsman.
Off duty.

[27] Adapted from Hospital Corps Handbook, 1949.

Sample routine of the ward during the night (duties of the night corpsman)

2050 Report for duty. Receive report from day corpsman and p. m. nurse corps officer.
Discuss and understand all reports, orders, and duties.
Make actual bed check against ward roster and liberty list.

2100 Send muster report to night master at arms.
Start night log.
Check orders with night nurse corps officer; find out how to contact her when needed; notify her of any patient's complaints, change in condition, any unusual happening on ward.

2130 Organize work for the night. Note or make a memorandum of medications, treatments, nursing care to be given during the night, cleaning details (hypo, thermometer trays; solarium; dressing cart) to be done.
Plan to make frequent rounds during the night. At least hourly on entire ward and more often to seriously ill patients.
Record in night log after each round.
Record in patient's charts all observations as they occur, medications and treatments after they are given.

0100 First watch to supper.

0130 Relief watch to supper.

0400 Quietly organize work and equipment for morning care.

0600 Lights on. Reveille. Morning care to bed patients.
Medications and treatments as ordered. Collect specimens; check off those collected in report book; record on patients' charts.
Complete and sign night log and patients' charts.
Square away service rooms, desks, nurses' station.

0700 Give report to day corpsmen.
Take specimens to laboratory.
Off duty.

Sample routine of corpsman on special watch—night duty

2050 Report to nurse corps officer.
Receive and understand patient's orders.
Take complete care of the patient.
Make a memorandum of medications and treatments, nursing care to be given, observations to be made.
Check your plan of care with the nurse officer.
Start patient's chart. Record all observations, medications, and treatments as they occur or are given.
(See "The seriously ill or dying patient.")

0130 To supper when properly relieved.

0600 TPR, medications and treatments as ordered.
Give complete bath, change linen, and clean and square away room or unit.

0645 Complete and sign patient's chart.

0700 Give report to relief corpsman and day nurse corps officer in charge of ward.
Take specimens, if any, to laboratory.
Off duty.

NOTE.—The routine of corpsman on special watch during the day follows the same general outline.

Sample Cleaning Schedules of the Ward

Daily cleaning—Decks

1. Sweep down after meals, using sweeping compound. Swab stone, unpolished wooden and linoleum decks.
2. Buff decks each morning.
3. Scrub shower and head decks each a. m. and p. m.
4. Scrub galley deck each a. m. and p. m.

Bedside units

1. Damp dust lockers, beds, chairs, lamps, window sills each a. m.
2. Line up beds, chairs, lockers each a. m., p. m., p. r. n.

Service rooms

1. Clean sinks, hoppers, working surfaces each a. m. and p. m.
2. Swab decks each a. m. and p. m.

Weekly cleaning—Monday

1. Routine daily cleaning.
2. Damp dust vents, signal buzzers. Dust electrical fixtures.
3. Clean radiators, electric fans.
4. Clean wheel chairs and special equipment.

Tuesday

1. Routine daily cleaning.
2. Wash beds, springs and mattresses, chairs, inside and outside of lockers.
3. Polish bright work.

Wednesday

1. Routine daily cleaning.
2. Dust screens with a brush.
3. Wash windows and venetian blinds.
4. Dust walls with cleaning cloth attached to a long-handled broom.

Thursday

Field day—any day before inspection.

1. Routine daily cleaning—wax decks. (Exception: orthopedic wards.)
2. Clean medicine lockers, cabinets, desks, cupboards.
3. Wash stretchers, wheel chairs, irrigating stands, screens, overbed tables.
4. Clean gear, gear lockers, racks. Swabs should be "twirled and spread out" to dry (in sun if possible). Clean brooms and dust pans.
5. Check all cleaning details.

Friday

1. Routine daily cleaning.
2. For captain's inspection, open locker, cabinets, desk drawers. Line beds, chairs, lockers. Open windows evenly; line up venetian blinds and shades.

Saturday and Sunday

Routine daily cleaning.

Ward routine and cleaning schedules may be modified in different stations due to local conditions.

Sample Routine For Inspection

Ward is in order and all patients are present unless excused by ward medical officer.

Ward medical and nurse officers and senior corpsmen stand at entrance to the ward. Other personnel continue with assignments.

Duties of Senior Corpsman:

1. Stand at entrance to ward equipped with a flashlight, ward keys, and a hand towel dampened with water at one end.
2. On arrival of the inspection party, call the ward to attention.
3. Precede the inspection party; turn on lights, open doors as the party progresses through the ward.
   a. Adjust the pace of the inspection to the desires of the inspecting officer.
   b. Offer the dampened towel for the inspecting officer's hands when needed.
   c. Be prepared to answer questions concerning the patients and the ward.
   d. Be attentive to all suggestions made by the inspecing officer.
   e. Escort the inspection party to the exit of the ward.
4. When the inspection party has left the ward, announced "Carry on." Continue with ward routine.

WARD RECORDS AND REPORTS

Ward records and reports may be classified into two groups:

1. Records and reports used in the internal operation of the ward, such as:

   Ward Report Book.
   Doctor's Order Sheets.
   Report at Change of Watch.
   Ward Roster.
   Diet List.
   Narcotic Book.
   Temperature-Pulse-Respiration Book.

2. Records and reports prepared by the ward for other departments:

   Ward Report.
   Diet Sheet.
   Laundry List.

Consult the station orders for any additional records or reports required and for the disposition of completed records or books as prescribed by the local station.

Records and Reports Used on the Ward

Ward report book.

Purpose: To provide a record of ward activities for the information of corpsmen, doctors, and nurses.

Indicated for all wards.

Contents

Census and changes in census. (Heading.)
Condition of patients. (Body of Report.)

Suggested form

Headings

Ward ------ Date ----------

Census @ 0700	@ 1500	@ 2200

CLR------	Cap------	Watch List	
A------	Occ.------	Port	
AOW------	Vac.------	0800–1200	------(Names)------
TOW------	Sleeper------	1600–2100	------
D------	Leave------	Starboard	
DD------	------	0700–1600	------

		Night	
		2100–0700	------

Narcotics-- 0700 ------(Signatures)------NC	P. M. Sickcall
1500 ------NC	------(Signature)------
2200 ------NC	O. O. D.

A------	(Name)	(Rank or Rate)	(Diagnosis)	
AOW------ TOW------	}(Name)	(Rank or Rate)	(Diagnosis)	From Ward ------ to Ward ------
D------	(Name)	(Rank or Rate)	(Diagnosis)	
PAL------	(Name)	(Rank or Rate)	(Diagnosis)	Date------
AOL------	(Name)	(Rank or Rate)	(Diagnosis)	Date------

Body of Report

1. Record patients on the critical and serious lists, new admissions, and others requiring special care.
2. List their conditions, nursing care required, and any special information the other watches should know.

EXAMPLE

Port	Jones, John J. HA Diagnosis
1	1. Appears slightly improved.
C. L.	2. Give oral hygiene and back care q2h.
Sp. W.	3. Change position q2h.
	4. Restrict visitors to parents.
	5. Watch voidings; measure and record intake and output.
	6. Patient is allergeic to codeine!

3. List names and bed numbers of the patients who are to have a. m. care; are to have specimens collected; are to have special tests requiring delayed breakfasts, etc.; require special care.
4. Record any unusual happening on the ward (patient falling out of bed, fist fights, etc.).
5. Night watch will record after each round: changes in patient's condition; completion and check-off of assignments listed in 3 above; names of unauthorized absentees.
6. Ward Report Book must be signed by the person in charge of the ward (nurse officer or senior corpsman) on each watch.

Doctor's Order Sheets

Purpose: To provide a method for obtaining and executing the doctor's orders.

Equipment

1. Doctor's order sheets for all patients on the ward.
2. Manila folder or chart back.
3. Paper clips.
4. Metal marking tabs.
5. Alphabetical file tabs.

Procedure

1. Place doctor's order sheets in alphabetical order in a manila folder or chart back.
2. Place a blank sheet of paper on top of folder.
3. Keep this folder on the nurse's desk.
4. When the doctor writes and signs an order on the patient's order sheet, the patient's name is written on the blank sheet.
5. The corpsman or nurse officer initials the order on the order sheet and crosses the patient's name off the sheet on top of the folder when the order is noted and executed.
6. Use paper clips to mark those order sheets containing new orders.
7. Use metal marking tabs to mark the order sheets of patients who are on the C. L. or S. L. lists.

Sample Report at the Change of Watch

Purpose: To report the ward activities and the conditions of the patients to the personnel of the new watch present for the report.

Equipment

1. Ward report book.
2. Doctor's order sheets.

Procedure

1. Have nurses' station quiet and in order.
2. Have all personnel of the new watch present for the report.
3. Use both the report book and the doctor's order sheets.
4. Give the status of the ward from the headings of the ward report book.
5. Report all new orders directly from the doctor's order sheets.
6. Give any other information the new watch will need to know.
7. Discuss problems or procedures which have arisen or may arise.

Remember the team carries on for the entire 24-hour period!

Ward Roster

Purpose: To maintain an accurate list of all patients on the ward.

Equipment

1. Cardex file.
2. Admission cards (NAVMED 1285).
3. Bed numbers.

Procedure

1. Label cardex file pockets with the bed numbers on the ward. Number beds starting at left of entrance to ward. Uneven numbers designate left side of ward; even numbers right side of ward.
2. Place patient's admission card in cardex pocket corresponding to his assigned bed number.

Diet List

Purpose: To serve the proper food to each patient.

Equipment

1. Blank sheet of paper, or
2. Blackboard in diet kitchen.

Procedure

1. List all patients who are to be fed on the ward and in the mess hall.
2. List patients under the appropriate columns.
3. List type of diet under special diets.
4. Designate those patients who are to have nourishments by a capital "N" after their names.

Sample Form

Ward Date

On ward Mess hall

Reg.	Light	Soft	Liquid	Special	

Narcotic Book

Purpose: To maintain a permanent accurate record of narcotics on the ward.

Equipment: The narcotic book may be a 5 x 8 or 10 x 14 ledger book. Its pages should be divided into columns for date, hour, patient's name, each narcotic on ward, doctor's name, nurses' name.

Each narcotic charged to the ward must be accounted for and an entry must be made in the book:

1. Each time a new supply is received from the pharmacy.
2. Each time a narcotic is given.
3. Each watch following a complete narcotic count.
4. Each week showing totals of narcotics received, dispensed, and remaining on hand. These totals must balance.

Temperature-Pulse-Respiration (TPR) Book

Purpose: To provide a temporary record of the temperatures, pulses, and respirations (TPR) of all patients on the ward; to use when taking temperatures, pulses and respirations.

Equipment: The TPR book may be a 5 x 8 or 10 x 14 ledger book, depending upon the number of patients on the ward and the frequency in which recordings must be made.

Procedure

1. Place name of ward and date at top of page.
2. Rule page into columns for bed number, name of patient, and the number of columns needed for recording the temperature, pulse, and respiration.
3. List bed numbers in numerical order.

4. List patients' names according to their placement on the ward.

5. Place a check mark next to the patients' names who are to have q4h or qid recordings.

Use of Book:

1. Record all TPR's.

2. Circle elevations of temperatures of 100° F. or over with red pencil.

Records Prepared For Other Departments

Ward Report (Nav Med HF 9)

Purpose: To provide a correct daily patient census; to show a daily change in census.

Indicated: For all wards.

Send to record office by 0830 daily.—The ward report is used as a basis for filling out Form 10 by the record office. It may also be used by the agent cashier for meal checkage. The report must be accurate, complete and legible. The report covers a 24-hour period (0001–2400). The heading of the report shows the numerical census and change in census. The body of the report lists the names, rates and diagnoses of the changes which occurred in the previous 24-hour period. Both sections must be in complete agreement. The "census last report" must agree with the total remaining from the last ward report. All changes in the patient census should be listed as they occur. Check station orders for any additional information required at your station.

Diet Sheet (Nav Med HF 18)

Purpose: To obtain adequate foods from the commissary for the patient.

Indicated: For all wards.

Send to diet kitchen by 0830 daily.—Be sure to order enough diets for all your patients but do not pad the requisition. Fill in the top section of the sheet as directed on the form; specify the number of patients eating on the ward or in the mess hall for all diets. In the body of the report list by name those patients on other than regular diets. Specify type of special diet and whether it is to be served on the ward or in the mess hall.

In some stations a "cripples' mess" is maintained. If such is the case, list the names of those patients who are to eat in this mess.

Check station orders for additional information required on sheet and directions for ordering nourishments and staples.

Laundry List

Purpose: To order linen from linen room.

Indicated: For linen exchange on days specified in station orders.

Send to linen room on days and at times specified.

The laundry list is made out in duplicate. The original goes to the laundry or linen room with the soiled linen. The copy is retained by the ward. The linen is counted and totals placed in appropriate columns. The linen returned from the linen room is checked against the ward copy of the laundry list. Cleaning cloths, binders, and other items of linen not listed are written in on blank sections of the sheet.

WARD SUPPLY AND EQUIPMENT

The supply and equipment for ward use is classified as follows:

Expendable—Those items that are consumed in use, break easily or are inexpensive, such as paper, glassware, plastic drinking tubes.

Nonexpendable—Those durable items, such as furniture, instruments, vehicles.

Ordering Supplies and Equipment

Expendable items are ordered on the supply requisition (NavMed 1342) at the times specified in the local station orders. The form is self-explanatory.

Request sufficient amounts to last until the next ordering day.

Base order on the rate of use of the item.

Know the number of items in each ordering unit.

Example: The ordering unit for "Ward Report" is 1 pad. Each pad contains 100 report blanks; therefore 1 unit should be enough for a 3-month supply.

Nonexpendable items are ordered on the "Equipment Voucher" (Form 111) when new equipment is desired, when equipment is returned to the storeroom or when it is surveyed for repair or disposal. The form is self-explanatory.

Care and Use of Supplies and Equipment

All ward personnel and patients are charged with the conservative use of government materials. The custody of nonexpendable items is charged to the ward medical officer but all personnel and patients should endeavor to keep this equipment on the ward and in good condition.

Metalware

General instructions

1. Rinse with cold water.
2. Wash with warm soapy water.
3. Boil 20 minutes.
4. Use mild scouring powder or sand soap for removing stains.
5. Rinse with hot water; dry.
6. Stow in proper place.

Bedpans and urinals

1. Cleansing by automatic bedpan sterilizers.
   a. Place in apparatus; push flush lever.
   b. After flush, press steam lever for one minute.
   c. Carry out steps 4–6 in general instructions above.
2. Manual cleansing.
   a. Rinse with cold water.
   b. Clean with brush and soap solution under running water.
   c. Rinse well with hot water.
   d. Boil in utensil sterilizer 20 minutes.
   e. Stow in rack.

Instruments

1. Rinse in cold water.
2. Separate blunts and sharps; unclasp hinged instruments.
3. Wash in warm soapy water; use brush and sand soap as needed for serrated parts.
4. Dry carefully. Reassemble hinged instruments; oil hinges very lightly.
5. Stow in cabinet.

Points to remember

1. Acids, bichloride of mercury, and chloride of lime corrode and stain steelware (CRM ware).
2. Enamelware chips easily.
3. Metalware dents easily when dropped or banged.

Glassware

General instructions

1. Rinse with cold water.
2. Wash with warm soapy water to which ammonia has been added (4 cc. to 1,000 cc. water).
3. Inspect for chips and cracks.
4. Stow in proper place.

Tubing, connecting tips

1. Soak in hydrogen peroxide if coated or blocked with organic residue.
2. Use cotton applicators to clean inner surfaces.

Syringes

1. Separate barrel and plunger after rinsing with cold water.
2. Soak in dilute hydrochloric acid for 20 minutes if syringe is clouded or sticky.
3. Use a small bottle brush or cotton applicator to clean the barrel.
4. Match barrel and plunger according to number etched on the sides.

Points to remember

1. Survey all chipped or cracked glassware.
2. Never boil a syringe with plunger in barrel.
3. Wrap glassware in gauze or muslin, when sterilizing by boiling, to prevent breakage.

Rubber goods

General instructions

1. Wash with cool soapy water; rinse well with clear water; dry thoroughly.
2. Roll or hang in cool place.

Tubing, catheters, rectal tubes

1. Rinse under cold running water.
2. Wash with cool soapy water; rinse.
3. Use cotton applicators if needed, to clean openings (eyes) of catheters and tubes.
4. Wrap in gauze; boil for 5 minutes.
5. Dry, drain, stow in coils without kinks.

Hot water bottles, ice bags

1. Wash with warm soapy water; rinse with clear water; dry; drain.
2. Inflate bag; apply cap.
3. Stow in cool place (preferably hanging up).

Air rings

1. Rinse with cold water; wash with warm soapy water; rinse with clear water; dry.
2. Inflate; powder lightly, and stow hanging up or flat in drawer.

Gloves

1. Rinse in cold water.
2. Wash in warm soapy water; rinse; test for holes; dry; arrange in pairs.
3. Send to central supply room.

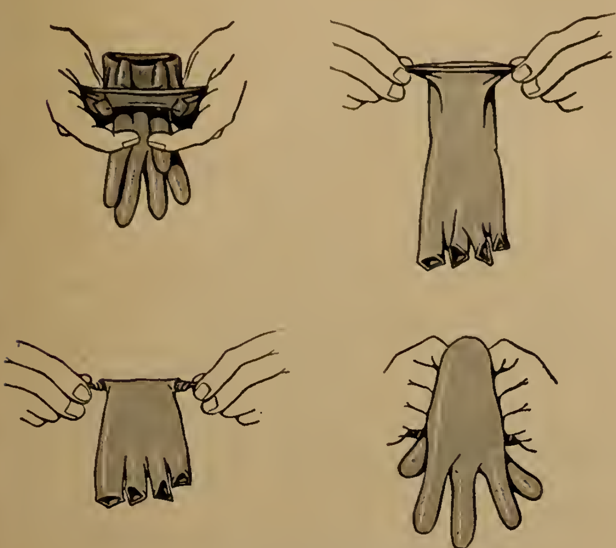

Figure 321.—Method of Inverting Rubber Gloves.

Points to remember

1. Oil, heat, soap, cresol, and sunlight deteriorate rubber.
2. Rubber goods must be dry when stored.
3. Do not dry rubber goods over a radiator or store near hot pipes.
4. Always roll rubber sheets; never fold them.
5. Always remove clamps from tubing before boiling.

Care of Linen

A. Control the supply of linen

Correct daily exchange

Count each piece of linen. Record totals on laundry list in duplicate. Original goes with linen to laundry, copy kept in ward.

Check linen from laundry against ward copy. Get I O U for any linen owed by linen room.

Weekly inventory

Follow instructions in station orders.

Make actual count of all linen on ward. Record in "Charge on Hand Book." Check with laundry lists and I O U's of the past week for totals.

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Send charge book to senior nurse corps officer who reports through official channels to the commanding officer.

Locked linen locker

Keep keys on person.

Allow only staff personnel access to linen locker.

Require up patients to obtain clean linen on exchange basis. Keep linen in orderly arrangement, shelves clearly marked, linen neatly stacked.

B. Proper use of linen

Insist upon linen being used as intended, pillow case for pillow, towel for bathing the patient. Cleaning cloths may be obtained from linen room by requesting them on laundry list.

Torn linen:

1. If soiled, place in hamper for laundry.
2. If clean, fold with tear uppermost; put aside in linen locker.
3. Send to linen room on specified day on an exchange basis.

C. Protect linen

1. Use rubber pillow cases and sheets when patient is incontinent, vomiting, hemorrhaging, has discharge, or wet dressings.
2. When stripping the bed, lift mattress with one hand and loosen bedding with other hand to avoid tearing sheets on bedsprings.
3. Remove stains before sending linen to laundry.
4. Obtain special linen from linen room for patients whose treatment causes staining of linen.

Figure 322.—Protecting Linen.

Removal of stains

Remove as soon as possible.

Use simplest method first. Stretch stained portion over sink or basin, stained side down; pour cold water through stain.

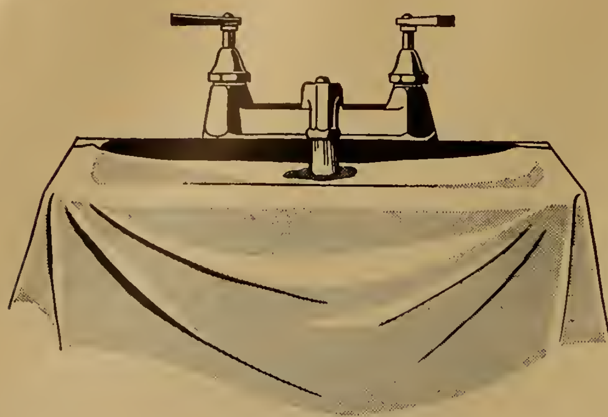


Figure 323.—Removing Stains.

Blood stains

Fresh.—Same as above.

Old.—Add ammonia to warm soapy water.

On mattress.—Apply paste of talcum powder or starch; let dry; brush well. Repeat until stain disappears.

Feces.—Same as in general.

Medicine.—Pour cold water through stain: use alcohol for tinctures.

Ink.—Apply salt paste: soak in lemon juice. Dry in sunlight.

Fruit.—Pour boiling water through stain.

Care of Cleaning Gear

Swabs

1. Stow in swab racks outside the ward.
2. Wash with hot soapy water twice weekly.

Push brooms

1. Stow in gear locker, brush head up.
2. Use for dry sweeping or with compound.

Dry mops

1. Stow in gear locker, mop head up.
2. Send mop head to laundry weekly.

Cleaning cloths

1. Wash with hot soapy water after use.
2. Allow cloths to dry before placing them in the hamper.
3. Obtain cleaning cloths from laundry.

The Drug Supply of the Ward

The ward should be stocked with enough drugs to last 24 hours or over a week end. Drugs should be stored in the medicine locker. Those drugs requiring refrigeration should be stored in the galley refrigerator.

Care of the medicine locker

1. Keep the medicine locker locked. The key should be carried by the corpsman in charge of medications.

2. Store narcotics in a separate locked cabinet within the medicine locker. The key must be carried by the nurse officer in charge of the ward.

3. Arrange drugs within the locker in an orderly manner. Be sure all labels are plainly visible. Suggested arrangement:

Upper section:

Top shelf—liquids for internal use.

Middle shelf.—Capsules, pills, powders; grouped according to their use.

Lower shelf.—Drugs to be used externally, such as eye drops, nose drops, ointments. Narcotic locker containing all narcotics, barbiturates, mixtures containing opiates.

Lower section:

Left side:

Top drawer.—Drugs to be given by injection and emergency stimulants.

Second drawer.—Sterile autoclaved syringes and needles, tourniquets, and covered container of alcohol sponges.

Right side:

Cabinet.

First shelf.—Oral medicine tray.

Bottom shelf.—Poisons in poison bottles with poison labels.

4. Post a list of symbols, abbreviations, and equivalents on the inside of the medicine locker door.

5. Cleaning the locker:

Wipe shelves daily when checking supply.

Start at the top; remove only a few bottles at a time.

Clean entire locker inside and out weekly.

Caution.—If interrupted, be sure to return all drugs and lock locker before leaving.

6. Drugs requiring refrigeration are stored in one section of the refrigerator. They are—

Saline cathartics, oils, suppositories.

Sera, vaccines, antibiotics, and biologicals.

Maintain drug supply.—When ordering drugs:

1. Check drug supply in locker and refrigerator each morning before sick call.

2. Make out order in drug book. Use intelligence in ordering; order according to the rate of use. The amount of drug you order will depend upon how often it is given, the size of the dose, and the number of patients receiving it.

3. General rule to follow when ordering drugs:

If item is used in dosages of—	*Order in quantities of—*
Drop or minim	10–30 cc.
4–16 cc.	100–250 cc.
16–30 cc.	500–1,000 cc.
30–100 cc. or over	1,000–4,000 cc.
1–2 tablets or pills	50–100 tablets or pills.

4. Return to pharmacy—

All drugs in poorly labeled or unmarked bottles or boxes.

All drugs not in current use.

All drugs showing a change in color, odor, or consistency.

5. Make out prescription blanks for alcohol, narcotics, and other drugs as required by station orders.

6. Present drug book and prescriptions for doctor's signature at Sick Call.

7. Send drug basket, drug book, and prescriptions to the pharmacy by 0930.

SUGGESTED ADDITIONAL READING—UNIT V

BARRETT, JEAN. *Ward Management and Teaching.* New York: Appleton-Century-Croft Inc., 1949.

YOUNG, HELEN; LEE, ELEANOR, and ASSOCIATES. *Essentials of Nursing.* 2d ed. res. New York: G. P. Putnam's Sons, 1948. Pp. 503–515.

INTRODUCTION TO THE OPERATING ROOM AND CENTRAL SUPPLY—UNIT VI

The purposes of this section are to acquaint the general service corpsman with:

1. The preparation and sterilization of surgical supplies and equipment.

2. The preparation of the operating room for general surgery.

The methods and procedures outlined are those of several stations and therefore are general rather than specific practices. The corpsman is advised to refer to the local station orders for routines pertaining to his particular situation.

PREPARATION OF SUPPLIES AND EQUIPMENT

Review—Chapter III, "Inflammation"

"Wounds"

Unit III, "Surgical Dressings"

SURGICAL ASEPTIC TECHNIQUE

Methods developed in the care of the patient with an open area which will protect him from possible infection carried in the air, by the worker and his equipment, or by other patients are termed surgical aseptic or "sterile" techniques.

Any measure used to prevent the spread of infection for any patient is part of surgical aseptic technique. Full surgical aseptic technique is practiced in the operating room. Modifications or adaptations of these techniques are carried out on the wards when doing dressings or treatments, such as, injections, instillations, irrigations, or removal of body fluids.

Principles of Surgical Aseptic Technique

1. All articles used in direct contact or indirect contact with a wound must be sterile.

2. The best available method of sterilization must be used in preparing supplies.

3. A sterile article must be labeled with the date of sterilization.

4. Articles not used within 7 days of the date of sterilization must be opened, inspected, rewrapped and resterilized.

5. The transfer of organisms from the clothing of personnel to sterile areas must be prevented.

6. The skin of the patient and of the personnel must be made as clean as possible.

7. Contamination of sterile areas or supplies by airborne organisms must be prevented.

The use of mechanical agents to carry out these principles are: caps, masks, gowns, gloves and instruments and **handwashing.**

For other applications of the principles of surgical aseptic techniques see:

Surgical Dressings, pp. 251–256.

Preoperative Skin Preparation, pp. 274–277.

DISINFECTION AND STERILIZATION

Purpose: Disinfection—to destroy pathogenic organisms; sterilization—to destroy all organisms.

Cleaning.—All articles must be thoroughly cleaned before any disinfection or sterilization is attempted. The washing and scrubbing with soap, water and a mild abrasive mechanically remove many bacteria. All cleaned articles must be rinsed in clear water to remove the cleansing agents.

Methods of disinfection and sterilization

The selection of a method for disinfecting or sterilizing an article depends upon:

1. The composition of the article (metal, glass, rubber, plastic, tissue).
2. The nature of the organism to be destroyed.
3. The time required to destroy the organism.
4. The nature of the disinfecting agent.
5. Cost.

Physical agents used in sterilization

The physical agents used are moist or dry heat.

Important points to remember when using these agents are the **temperature** required, the **time** required, and **contact by heat** with all parts of the article being sterilized.

Boiling water (utensil and instrument sterilizers)

1. Used for metalware, glassware, some rubber goods. Do not use for plastics or hard rubber articles.

2. The article to be boiled must be completely covered by water. Wrap rubber goods in gauze or old linen to keep them submerged during boiling period.

3. Allow enough room in the sterilizer for all articles to be in contact with the boiling water.

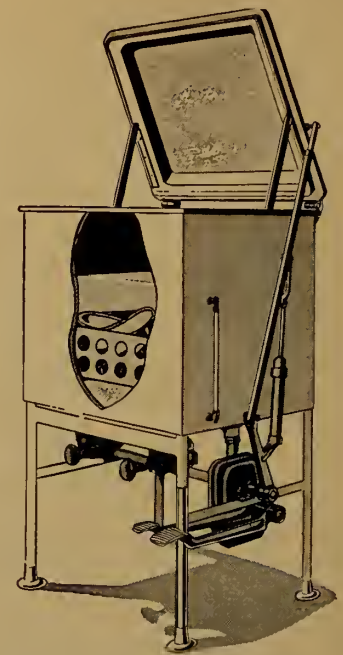


Figure 324.—Utensil Sterilizer.

4. Time: 10 minutes for small articles (syringes, rubber tubing); 20 minutes for large articles (basins, pitchers).

The boiling period is timed from the start of vigorous boiling. When this period is reached, reduce steam sufficiently to maintain boiling point without wasting steam.

Steam under pressure (autoclave)

1. Method of choice for metalware, glassware, rubber tubing, gloves, and dry goods.

2. The articles must be wrapped or placed in a container before sterilization.

3. Each article must be labeled with date of sterilization.

4. Articles to be autoclaved should be as nearly the same size and type as possible.

5. Allow enough space in the autoclave for all articles to be in contact with the steam. As each item is placed in the autoclave, imagine it to be filled with water. Place the item so that the water will drain out.

6. Use sterilizer controls (ATI or Diack control) in each load autoclaved.

7. Operating the autoclave.

Turn on steam valve.

Load autoclave.

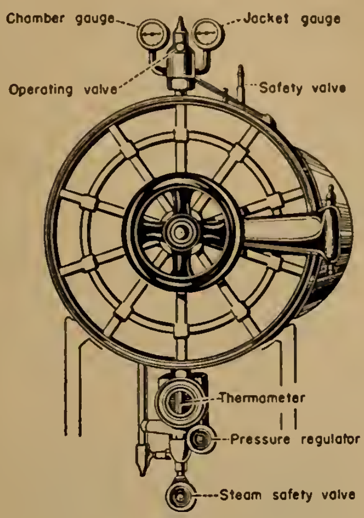


Figure 325.—Diagram of Autoclave.

Close door tightly when pressure in jacket reaches 17 pounds.

Turn operating valve to "sterilize."

Start timing sterilization period when chamber gauge registers 17 pounds pressure and thermometer registers 250° F.

Follow "8" below for sterilization period.

Turn operating valve to "exhaust" when time for sterilization is finished. (See par. 8.)

Turn operating valve to "vacuum" when chamber gauge reads "zero."

Allow to remain on "vacuum" 5 to 10 minutes, according to size of package being autoclaved.

Turn operating valve to "off."

Open door when gauge reads "zero."

Allow door to stand open 1 inch for 15 minutes.

Unload autoclave.

Check sterilizer controls. (Turn off steam supply if no further autoclaving is to be done.)

8. Time (250° F. at 17 pounds pressure):

Dry goods (large packs), 45 minutes.

Dry goods (average packs) 30 minutes.

Unwrapped instruments or small instrument trays, 10 minutes.

Wrapped instruments or instrument trays, 30 minutes.

Wrapped rubber gloves, 15 minutes.

Flasks of solution two-thirds full: 1,000 cc., 15 minutes; 2,000 cc., 20 minutes.

Dry heat (hot air oven)

1. Used for ointments, oils, waxes and powders; may also be used for glassware, instruments, needles, dry goods.

2. Time—for oils, ointments, waxes, powders: 120 minutes at 320° F.; for glassware, instruments, needles, dry goods: 60 minutes at 320° F.

Flame (incineration):

1. Used for materials which can be burned—food, paper materials, dressings.

2. Time—until completely destroyed.

Sunlight

1. Used for clothing, bedding, and mattresses.

2. Time—6 hours or more in direct sunlight—on each side.

Chemical agents used in sterilization

Chemical disinfection or sterilization is used only when an article cannot withstand other measures of sterilization. There is no chemical disinfectant available which meets requirements for destroying all organisms on all articles. Essential factors are **strength of solution** required, **time required,** and **contact by chemical** with all parts of the article being sterilized or disinfected.

1. Quaternary ammonium compounds have been found to be effective in high dilutions and more effective in the presence of organic matter than many other disinfectants. However, they are not effective in the presence of soap or against the tubercle bacillus.

Used as a skin disinfectant in 1:1000–1:5000 dilutions.

Used as sterilizing agent for sharp and delicate electrical instruments. The quaternary ammonium compound most frequently used is: Benzalkonium chloride, 30 cc.; sodium nitrite, 30 cc. (Antirust agent.) Distilled water, qs, 4,000 cc.

Time: 30 minutes for vegetative bacteria; 18 hours for spore-forming bacteria.

2. *Cresol compound.*—Saponated cresol compounds cause tissue damage when used in strengths greater than one-half of 1 percent. Their primary

value lies in disinfection rather than in sterilization.

Used in a 4 percent solution to disinfect body excreta when precautions must be taken before disposal. May also be used for soaking bed linen when precautions must be taken before sending it to be laundered.

Time: 60 minutes.

3. *Alcohol.*—Alcohol is valuable for maintaining sterility after an article has been sterilized by other methods. Alcohol cannot be used for instruments that have plastic or cemented parts and it is not effective against spore-forming organisms.

Used in 70 percent solution as a skin disinfectant prior to the administering of injections or infusions; as a disinfectant solution for thermometers; to maintain sterility of syringes and instruments after they have been sterilized by other methods.

4. *Mercurials.*—The mercurials are effective against many organisms but they corrode metals and coagulate protein material such as sputum which provides protection for organisms.

Oxycyanide or mercury 1:1000 is sometimes used to sterilize the hermetically sealed glass tube of suture materials.

Time: 18 hours.

Preventing Contamination

To maintain sterility after an article is sterilized it must be protected from contact with unsterile areas.

1. Articles sterilized by boiling:

Use sterile forceps to remove article from sterilizer.

Immediately place the article in a sterile, covered container or wrap in a double thickness, sterile towel. Use care to avoid dripping water on the towel; if towel becomes wet, it is no longer sterile and the process must be repeated.

2. Articles sterilized by autoclaving.

Article is prepared and sterilized in the container or wrapper in which it can be stored.

Close the cover of metal containers before removing article from autoclave.

Be sure article is dry before removing from autoclave.

3. Articles sterilized by chemicals: Follow same procedure as "1. Articles sterilized by boiling."

PREPARATION OF SURGICAL SUPPLIES FOR AUTOCLAVING

General rules

1. All articles to be sterilized must be clean and in good condition.
2. Articles to be autoclaved must be wrapped in heavy paper, double muslin covers, or placed in metal or glass containers.
3. Packages and containers must be labeled.
4. Packages and containers must be dated after autoclaving.

Linen (masks, gowns, sheets, towels)

1. Inspect all linen for holes, tears, weak spots.
2. Roll masks singly and pack loosely in metal containers or paper bags.
3. Fold gowns lengthwise, wrong side out, roll from hem to neckband. Wrap singly in paper or double muslin covers.
4. Fan fold sheets and towels so that edges are on the outside. Wrap singly in paper or double muslin covers.
5. Time—250° F. at 17 pounds pressure.
   a. Large packages or containers—45 minutes.
   b. Average packages or containers—30 minutes.

Dressings

1. Compresses, applicators, cotton balls—pack loosely in metal containers or wrap in paper or double muslin covers.
2. Pads—fold pad in half, smooth side inside, and wrap singly in paper or double muslin covers.
3. Vaseline gauze strips.

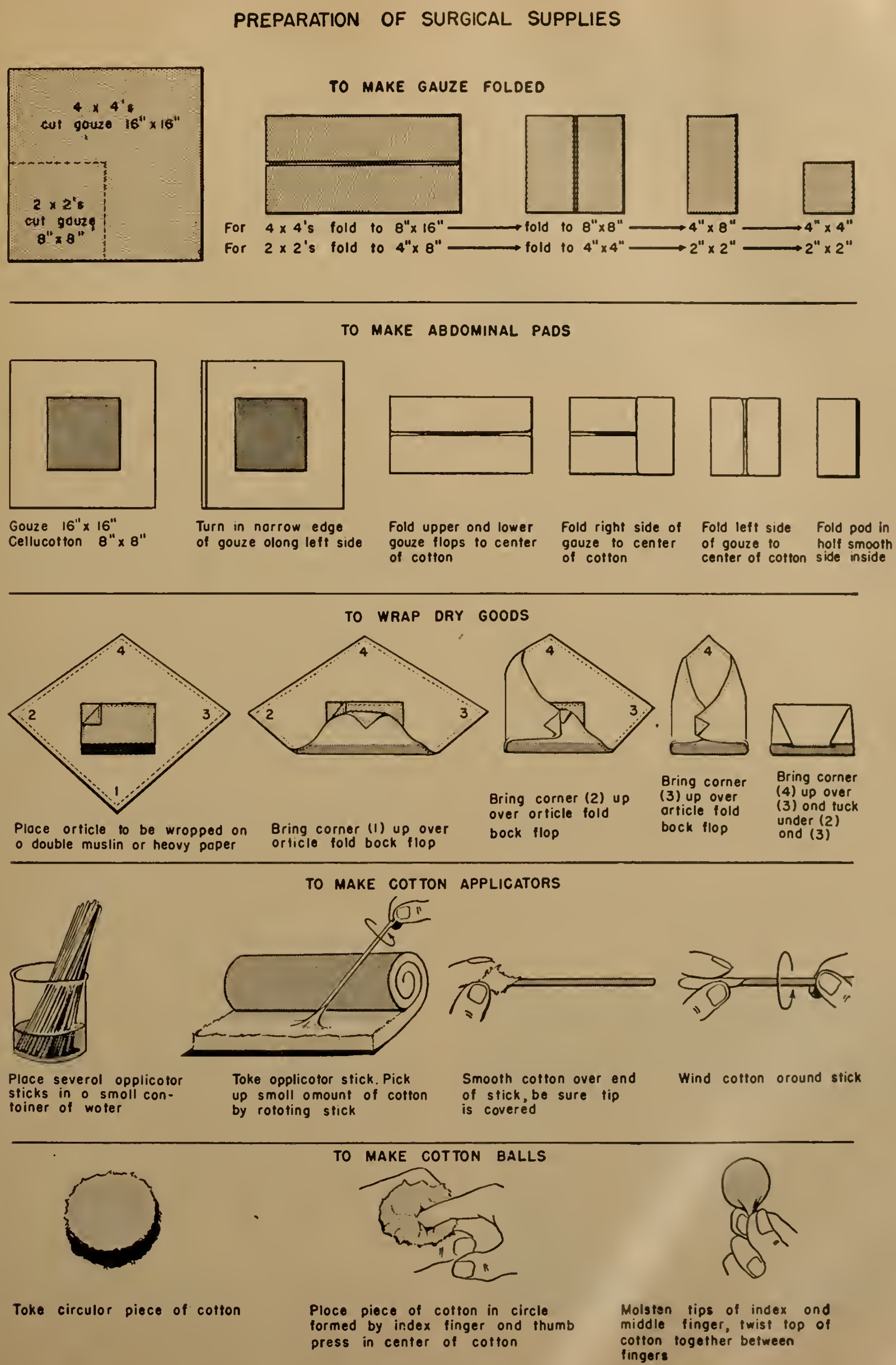
   Cut 2- or 3-inch gauze bandage into strips to fit the tray.

   Alternate strips of gauze with melted vaseline until tray is filled to within ¾ inch from the top.
4. Time—same as for linens.

NOTE.—Sterilization of vaseline gauze by hot air oven is recommended where available. Time: 120 minutes at 320° F.

Glassware (syringes, tubing, beakers, tips, jars)

1. Inspect all glassware for cracks or chips.
2. Wash with soap or detergent and water; rinse well.
3. Clean inner surfaces with applicators.



ure 326.—Preparation of Surgical Supplies.

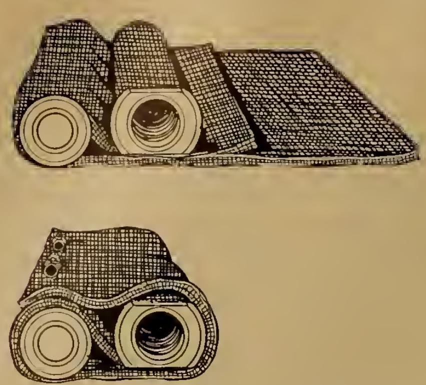


Figure 327.—Wrapping Syringes.

4. Syringes.

Match numbers on plunger and barrel.

Wrap plunger and barrel in gauze, separate surfaces by layer of gauze.

Wrap in paper or double muslin cover.

5. Tubing, beakers, tips.

Wrap in gauze, then in paper or double muslin covers.

When part of a sterile tray, always wrap in gauze.

6. Jars: No wrapping necessary: prepare same as regular glassware.

7. Time: Same as for linens.

Metal containers (cans, jars, trays)

1. Remove cover from container.
2. Place and tie a gauze cover over container.
3. Replace metal cover loosely on top of container.
4. Turn container on side in the autoclave to allow penetration by steam.
5. Time: Same as for linens.

Instruments

1. Wash instruments with warm soapy water; brush the hinged or serrated parts; rinse and dry.

2. Instrument trays.

Place a single thickness of linen in bottom of tray.

Open all hinged instruments.

Fill tray to within one-half inch of top by alternating a layer of instruments with a layer of linen.

3. In treatment trays, open hinged instruments.

4. Time: 30 minutes at 250° F. at 17 pounds pressure.

Needles (for injection, suture)

1. Inspect all needles for hooks and burrs.

2. Needles for injection.

Rinse with cold water.

Clean hub of needle with cotton applicator.

Pass a stilet through bore of needle.

Rinse needle with alcohol, ether. Dry with needle drier.

Insert a small piece of cotton in bottom of a glass tube; place the needle in the tube and plug the tube with cotton.

3. Suture needles.

Wash and dry needles. Scour with Bon Ami when necessary. Always clean toward point of needle.

Arrange needles according to type on a piece of gauze (straight, curved, round or cutting edge, tapered point).

Time: Same as for instruments.

Rubber goods (gloves, tubing, drains)

1. Gloves.

Inflate gloves. Test for holes.

Lightly powder gloves inside and out.

Sort into pairs; turn back a 3-inch cuff.

Place gloves inside muslin or paper glove holder. Add packet of powder.

Wrap package in a paper or double muslin cover.

Write glove size on the outside wrapper.

2. Tubing.

Remove all clamps.

Wash tubing with warm soapy water; rinse.

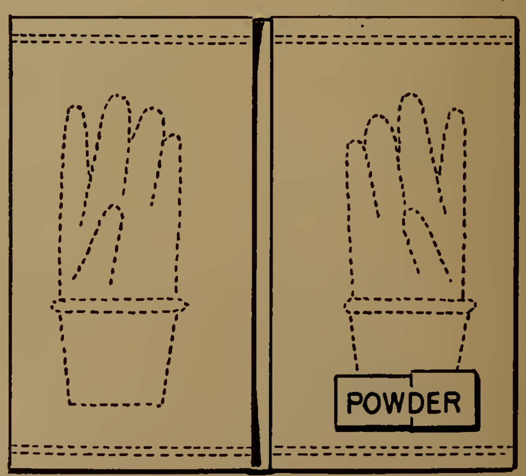


Figure 328.—Glove Wrapping.

Place flat in a container or wrapper or coil loosely without kinks in treatment trays.

3. Drains.

Rubber dam.

(1) Wash thoroughly in warm soapy water; rinse.

(2) Cut into lengths and widths as needed.

(3) Place flat in a metal container or suspend in a glass tube.

Cigarette drains:

(1) Wash thoroughly with warm soapy water; rinse.

(2) Insert gauze bandage through center of tubing.

(3) Place flat in a metal container or suspend in a glass tube.

Catheters:

(1) Wash thoroughly with warm soapy water; rinse.

(2) Place on covered wooden splints and wrap in double muslin or paper covers or place flat in metal container.

4. Time: 15 minutes at 250° F. at 17 pounds pressure.

Suture materials (catgut, silk, cotton linen, wire, horsehair, clips)

1. Silk, cotton, horsehair, nylon, linen.

Wrap material loosely about a piece of cardboard or cut into strands.

Place in a test tube and wrap in a double muslin cover; place in treatment or instrument tray.

2. Clips, treat same as above.
3. Time: Same as for instruments.
4. Suture material in hermetically sealed tubes.

Boilable—autoclave with treatment or instrument trays.

Nonboilable.

(1) Wash tube with soap and water; rinse.

(2) Place in a covered container of mercuric oxycyanide 1:1000 for 18 hours.

(3) Store in a covered container of alcohol 70 percent (Bethesda NNMC).

SELECTED STERILE TRAYS

These trays are equipped and stocked by the central supply room (CSR) or the central dressing room (CDR) in most naval hospitals.

Aspirating tray

One 3 cc. local set.
One 30-cc syringe with metal adaptors.

Figure 329.—Aspirating Tray.

Two culture tubes.
One No. 13 gage 2-inch needle.
One No. 15 gage 2-inch needle.
One No. 16 gage 1-inch needle.
One No. 16 gage 2-inch needle.
One No. 17 gage 3½-inch needle.
One No. 18 gage 2-inch needle.
One No. 19 gage 2-inch needle.
One No. 20 gage 3-inch needle.
One No. 20 gage 2-inch needle.
Six 4 x 4's.
Two drape sheets.
One towel.

Dressing tray

One surgical scissors.
One hemostat.
One thumb forcep.
Two applicators.
Four 4 x 4's.
One towel.

Figure 330.—Dressing Tray.

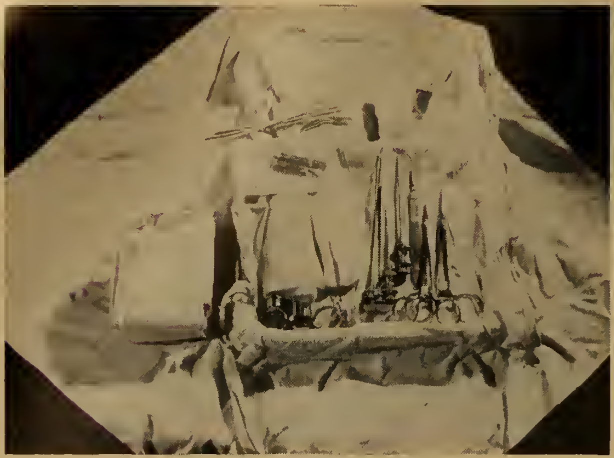


Figure 331.—Biopsy Tray.

Biopsy tray

One 10 cc. Luer Lok syringe.
Two 22 gage 3-inch local needles.
Two 26 gage hypodermic needles.
One No. 3 knife handle.
One No. 11 blade.
Two tubes plain 0 catgut.
Two liver biopsy needles.
One needle holder.
Three lengths 3-inch roller gauze.
One beaker.
Six 4 x 4's.
Six swabs.
Two field sheets.

Catheterization tray

One emesis basin.
Two beakers.
Two catheters No. 14, No. 16.
Six cotton sponges.
One specimen bottle.
One sheet.
Two 4 x 4's.
One tube of water soluble lubricant. (Not shown)

Figure 332.—Catheterization Tray.

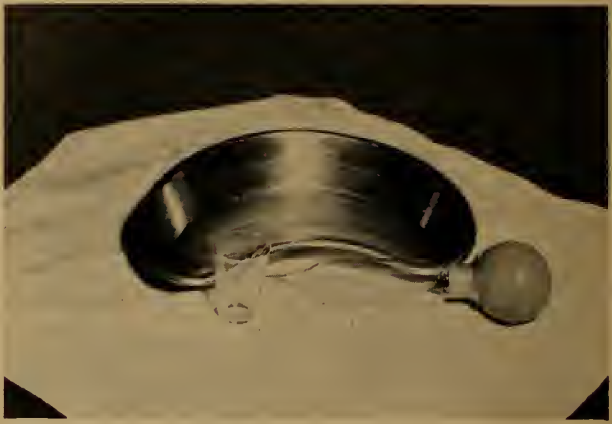


Figure 333.—G. U. Set.

G. U. set

One emesis basin.
One asepto syringe.
One medicine glass.
Two 4 x 4's.

Emergency suture tray

One knife handle No. 3.
One needle holder.
Two mosquito hemostats.
Two straight hemostats.
Two curved hemostats.
Two Allis clamps.
One tissue forceps.

Figure 334.—Emergency Suture Tray.

One rat tooth forceps.
One suture scissors.
One 3 cc. syringe with local set.
Three knife blades, Nos. 10, 11, 15.
Two towel clips.
One set suture needles.
Two black silk, No. 00, No. 000.
Two field sheets.
One drape sheet.
Four 4 x 4's.

Local set

One medicine glass.
One 3 cc. Luer Lok syringe.
One No. 22 gage 1½-inch needle.
One No. 23 gage ¾-inch needle.

Figure 335.—Local Set.

Lumbar puncture tray

One 10-cc. syringe.
One 20-cc. syringe.
One 2-cc. local set.

Figure 336.—Lumbar Puncture Tray.

One No. 18 gage spinal needle.
One No. 20 gage spinal needle.
Three specimen tubes with corks.
One drape sheet and towel.
Two applicators.
Four 4 x 4's.
One manometer. (Not shown)

Paracentesis tray

One 2-cc. syringe.
One No. 22 gage 1½-inch needle.
One No. 22 gage 2-inch needle.
One No. 23 gage ¾-inch needle.
One 30-cc. syringe.
One medicine glass.
One piece rubber tubing, 5 feet in length with glass connection.
One cannula, straight.

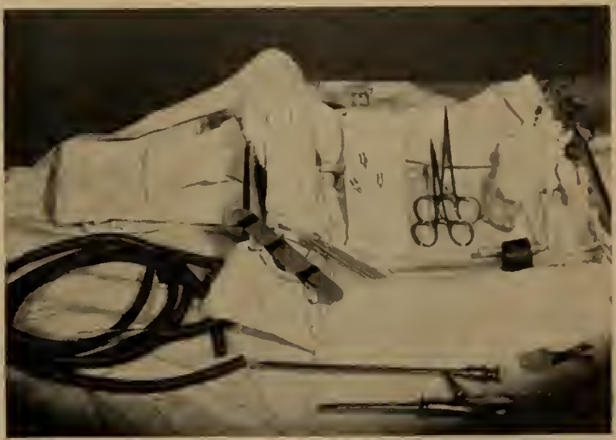


Figure 337.—Paracentesis Tray.

One two-hole rubber stopper with 4-inch straight glass rod.
One knife handle No. 2.
Two blades, No. 10, No. 11.
One set assorted suture needles.
One drape sheet.
Two field sheets.
Sixteen 4 x 4's.
One long piece rubber tubing.
One black silk, No. 0, No. 00, No. 000.
Two mosquito forceps.
One 3-way stopcock.
One right-angle glass tube.

Phlebotomy tray

One plain forceps.
One rat tooth forceps.

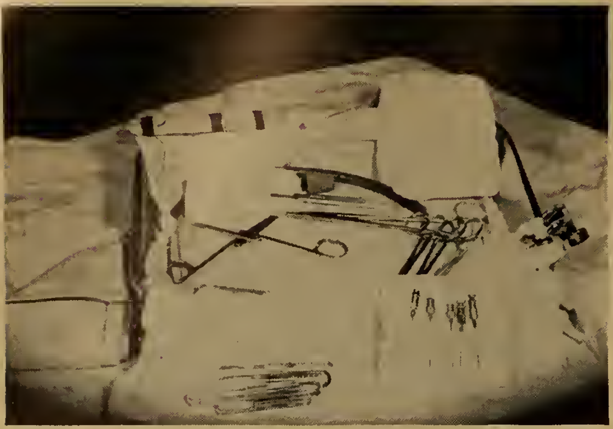


Figure 338.—Phlebotomy Tray.

Two mosquito hemostats, straight.
Two mosquito hemostats, curved.
One knife handle No. 3.
One straight scissors.
One needle holder.
One set knife blades, No. 10, No. 11.
One No. 18 gage needle.
One No. 20 gage needle.
One No. 15 gage needle.
One No. 18 and 1 No. 20 titus needle.
One medicine glass.
One 2-cc. syringe.
One set suture needles.
One set local needles.
One adaptor with rubber tubing.
One drape sheet.
One black silk No. 0, No. 00, No. 000.
Five 4 x 4's.
One tube No. 0 plain suture.
One tube 3–0; 4–0; 5–0 dermal suture.

Sternal marrow puncture set

One 2 cc. local set.
Two 2-cc. syringes.
One 10-cc. syringe.
Two curved mosquito hemostats.
One No. 3 knife handle.
One No. 11 blade.
Two sternal puncture needles.
Four 4 x 4's.
Two applicators.
Two right-angle tubes.
One field sheet.

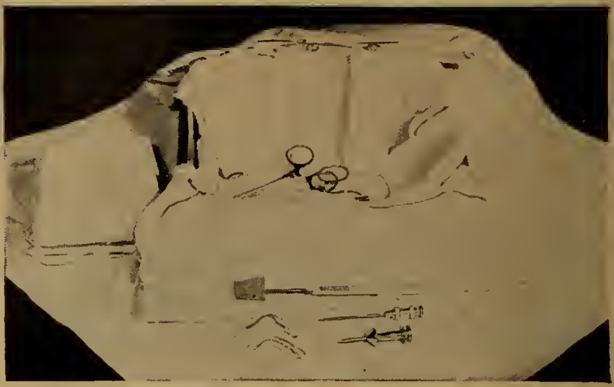


Figure 339.—Sternal Marrow Puncture Set.

Pneumothorax tray

Two towels.
Two No. 17 gage, 3-inch needles.
Three No. 18 gage, 2-inch needles.
Three No. 21 gage, 2-inch needles.
One 10-cc. syringe.
One 2-cc. syringe.
One No. 26 gage needle.
One black rubber tubing with needle adaptor and glass connection.
One medicine glass.
Two needle adaptors.
One 30-cc. syringe.
Aspirating needles.
Local needles.

Figure 340.—Pneumothorax Tray.

Venous pressure tray

One spinal manometer and stopcock. (Sterilize separately)
One 20-cc. syringe with No. 20 gage needles.
One T. B. syringe with No. 23 gage needles.

Figure 341.—Venous Pressure Tray.

One 10-cc. Luer Lok syringe with finger control.

Four 4 x 4's.

Thoracentesis tray

One medicine glass.

One 2-cc. syringe with No. 23, No. 26 gage needles.

One 30-cc. syringe with adaptor.

One Pilling guard.

One rubber tubing with needle adaptor.

Two No. 20 gage 2-inch needles.

One No. 18 gage 3-inch needle.

One No. 21 gage needle.

Two drape sheets.

One drape sheet.

One emesis basin. (Not shown)

Figure 342.—Thoracentesis Tray.

Figure 343.—Wet Dressing Tray.

Wet dressing tray

One asepto syringe.

One basin.

One thumb forceps.

One emesis basin. (Not shown)

Tracheotomy set

One Jackson aspirating tube.

Two small, medium, large silver tracheotomy tubes with tapes.

Two tracheotomy retractors.

Six curved hemostats.

One tracheal dilator.

One tracheal blunt bistoury.

One dissecting scissors, straight.

One thymus retractor.

One tracheal tenacuium.

One needle holder.

Four towel clips.

Figure 344.—Tracheotomy Set.

One 3-cc. syringe.
One No. 22 gage 1½-inch needle.
One No. 22 gage 2-inch needle.
One No. 23 gage ¾-inch needle.
Eight 4 x 4's.
Three drape sheets or towels.
Two assorted No. 0, No. 00, No. 0000, No. 00000 plain catgut.
One rat tooth forceps.
One plain forceps.
Two applicators, wooden.
One set suture needles.

PREPARATION OF THE OPERATING ROOM

Review Local Station Orders

The procedures outlined in these pages are those necessary to prepare the patient, personnel, and equipment for general surgery. The additional instruments and equipment required by the surgeon for a particular operation should be ascertained by the operating room corpsmen before preparations are begun.

The operating room

Cleaning.—Daily routine cleaning should consist of swabbing the floors and damp dusting all furniture. Each week the walls, floors, and furniture should be vigorously scrubbed with soap and water.

Lighting.—Overhead lights used to provide concentrated shadowless light during the operation should be checked each day.

Ventilation.—The temperature of the operating room should be constant, preferably 70° to 74° F. with humidity of 48 to 55 percent.

Furniture

Operating table.
Gown and drape table.
Double ring stand with tray secured over one ring.
Single ring stand.
Two instrument tables (Mayo stand).
Anesthetist's table.
Anesthetist's stool.

Equipment for general surgery

General laparotomy pack

Two Mayo stand covers.
Four packs 4 x 4 gauze (12 per pack).
Two upper sheets.
One single fold sheet.
One laparotomy sheet.
Fifteen towels.
Five 10 x 10 sponges.
Five 2 x 10 sponges.
Three gowns.
One special bag containing one ABD pad, one roll hernia tape, eight safety pins, three cotton swabs.

General instrument tray

Two No. 3 knife handles.
Two plain thumb forceps.
Two rat tooth thumb forceps.
One Russian dressing forceps.
Two needle holders.
One suture scissors.
One curved Mayo scissors.
One straight Mayo scissors.
One Metzenbaum scissors.
One probe.
One groove director.
Two Michel clip holders and clips.
One ribbon retractor.
One pair Parker retractors.
One pair Richardson retractors.
One pair medium Deaver retractors.
Twelve small curved Kelly hemostats.
Twelve small straight Kelly hemostats.
Six Allis clamps.
Six Kocher clamps.
Three Babcock intestinal clamps (two small, one large).
Twelve towel clips.
Twelve sponge forceps.
One needle book.
One pair Army retractors.

The laparotomy pack and instrument tray are wrapped, autoclaved and kept in readiness for immediate use at all times.

The operating room personnel

The surgeon, his assistants, the anesthetist, the operating room nurse and corpsmen change their uniforms for operating room clothes.

Duties of the circulating corpsman

Before the operation

1. Damp dust all furniture in the operating and scrub rooms.
2. Set up scrub room.
3. Set up operating room; bring all necessary supplies, set furniture in proper places, adjust lights, check working order of all electrical units.
4. Assist scrub corpsman in donning gown and gloves. Open laparotomy pack for scrub corpsman.
5. Preparation of the patient:

   Place patient on table in the proper position.

   (1) For general anesthesia, place restraint over patient's knees, secure his arms at the sides.

   (2) Spinal anesthesia. Place patient on his side, with knees flexed and head drawn on his chest until after anesthesia has been given. Remain with the patient and anesthetist during the administration of the anesthetic.
6. Remove all sponges used for the anesthesia and preparation of the skin from the room before the case begins.

During the operation

1. Remain in the room at all times.
2. Anticipate the needs of the "scrubbed" corpsman and surgeon.
3. Keep sponge count. Before the peritoneum is closed, check with scrub corpsman. The number of used sponges, the number the scrub corpsman still has must equal the total number of sponges placed in the operating room. If the count is not correct, the surgeon must be told and search instituted for the missing sponges.

After the operation

1. Assist in applying the outer dressing.
2. Bring stretcher into room and assist in lifting the patient from the table.
3. Cover the patient and send him with a corpsman to his ward.

Duties of scrub corpsman

1. Scrub, don gown and gloves.
2. Drape each table and stand with cover, field cloth, and towels.
3. Place basins in ring stands.
4. Arrange instrument table and ring stand.
5. Prepare spinal tray if spinal anesthesia is to be given.
6. Prepare sponge sticks for painting the operative site.
7. Assist with draping the patient.

   a. Four towels placed to expose operative site; secured by clips.

   b. Sheet over upper part of patient and screen.

   c. Sheet over lower part of patient.

   d. Laparotomy sheet over the entire patient with the opening directly over the operative site.

   e. Two towels secured by towel clips directly over site so that only operative area is exposed.
8. Move the instrument table up into place.
9. Prepare sutures.
10. Anticipate the surgeon's and his assistant's needs.
11. Keep sponge count. Check with circulating corpsman before the closing of the peritoneum.

Preparation of the scrub corpsman

Cap and mask.—Cap and mask are clean rather than sterile and are donned before scrubbing hands or putting on sterile gown and gloves. The cap must completely cover the hair and mask cover the nose and mouth.

Hand Washing Technique

Methods

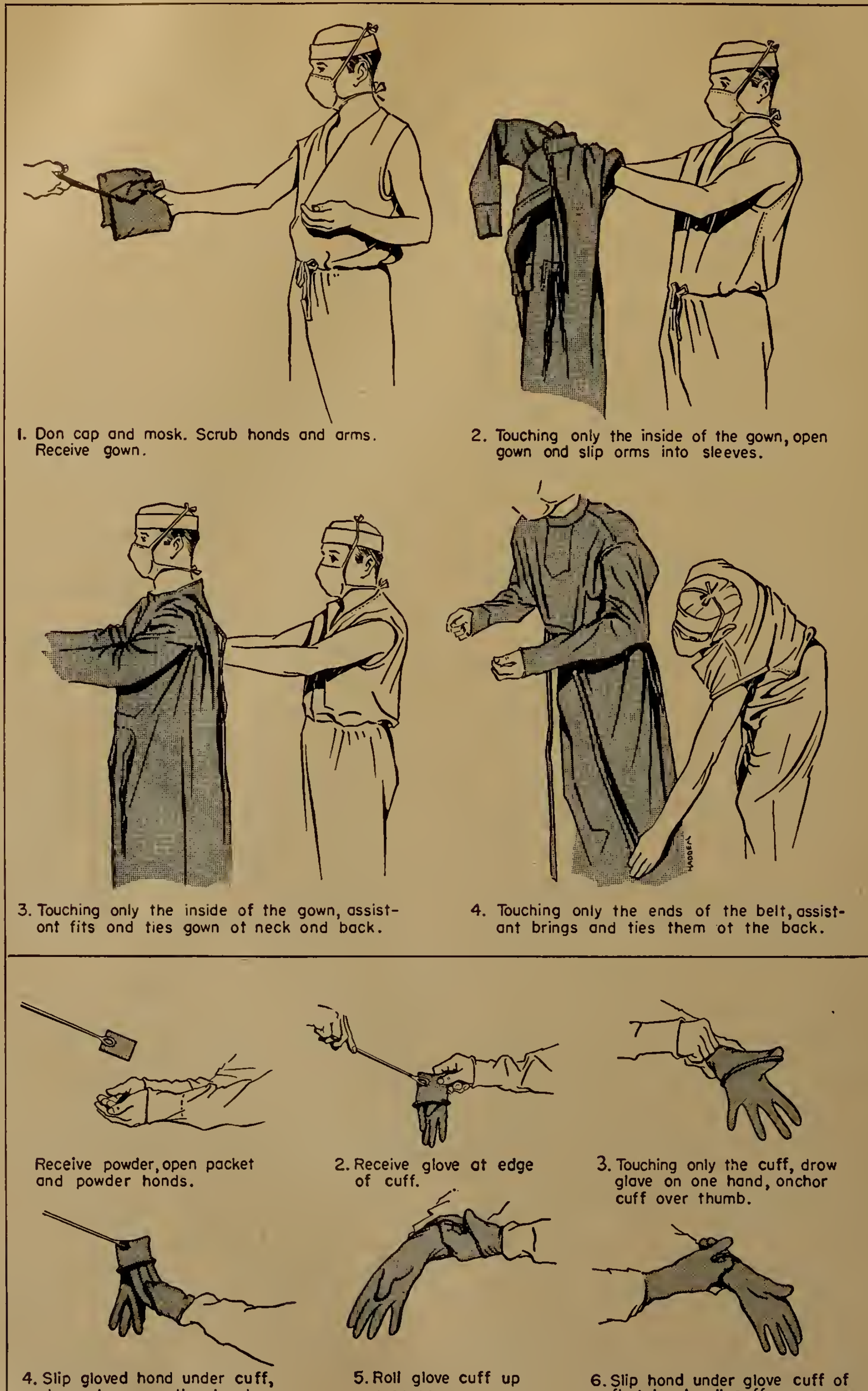
1. *Using running water and detergent:*

Preliminary wash: 1 minute—wash hands and arms to 2 inches above elbows. Clean nails with nail stick. Rinse by holding hands up, allow water to drain off elbows.

Systematically scrub hands and arms with a sterile brush and detergent.

(1) Begin at outer surface of the thumb; proceed to the inner, then to each finger; scrub the palm of the hand, then the back of the hand. Repeat for the other hand.

(2) Scrub in a circular motion toward the elbows.



1. Don cap and mask. Scrub hands and arms. Receive gown.

2. Touching only the inside of the gown, open gown and slip arms into sleeves.

3. Touching only the inside of the gown, assistant fits and ties gown at neck and back.

4. Touching only the ends of the belt, assistant brings and ties them at the back.

Receive powder, open packet and powder hands.

2. Receive glove at edge of cuff.

3. Touching only the cuff, draw glove on one hand, anchor cuff over thumb.

4. Slip gloved hand under cuff, draw glove on other hand.

5. Roll glove cuff up over gown.

6. Slip hand under glove cuff of first hand, roll cuff up over gown.

Figure 345.—Donning Gown and Gloves. Surgical Aseptic Technique.

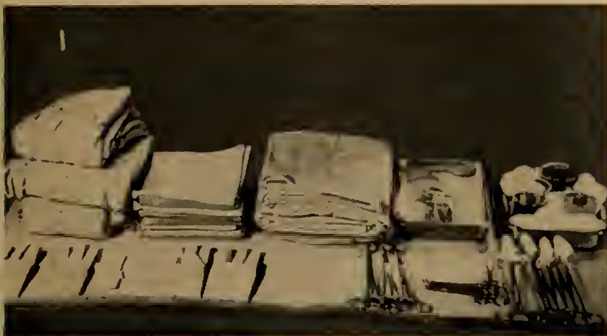


Figure 347.—BACK TABLE. Left to right. Front row: Gloves, powder for gloves, 3 sponge sticks, 4 skin towel clips, 4 sponge sticks with sponges for preparing field of operation. Back row: Three gowns, 8 towels, 3 sheets (1 laparotomy), sutures, skin preparation tray. This table is covered and pushed out of the way after the personnel are gowned and patient is prepared and draped.

Figure 348.—RING STAND. Left to right. Front row: Five 10 x 10 sponges, needle book, 2 needle holders, 1 Russian dressing forceps, 2 Michel clip holders and clips, 1 groove director, 1 probe, 1 ribbon retractor.

Figure 346.—THE OPERATING ROOM. Front row: Circulating nurse, assistant, anesthetist. Back row: Scrub corpsman, surgeon.

Figure 350.—SPINAL ANESTHESIA TRAY. Left to right. Front row: Twenty cc. syringe, 2 cc. syringe, hemostat. Back row: Medicine glass with sterile saline, procaine, introducer, 2 spinal needles, 2 21 gage needles, 2 26 gage needles, 4 x 4 gauze.

Figure 349.—MAYO STAND. Left to right. Front row: Twelve small curved Kelly hemostats, 12 small straight Kellys, 2 rat-tooth forceps, 2 plain forceps, Metzenbaum scissors, straight Mayor scissors, curved Mayo scissors, 2 scalpels. Center row: Suture scissors, package 4 x 4 gauze, 2 tubes ligature ties. Back row: One large Babcock, 2 small Babcock intestinal forceps, 4 Allis forceps, 6 Kocher and 8 large Kelly hemostats.

Figures 346–350.—An appendectomy in progress. Note the placement of equipment and the positions of the personnel.

211866°—53——21

Scrub 4 minutes, rinse by holding hands up; allow water to drain off elbows.

Dry hands and arms with a sterile towel. Hold hands up!

2. *Using running water and green soap:*

Wash hands and clean finger nails with a nail stick.

Scrub hands and arms systematically with a sterile brush and tincture of green soap for 5 minutes as described above.

Discard first brush—with a new one, scrub for 5 minutes more.

Rinse and reapply soap frequently during scrub period.

After 10 minutes (total) rub alcohol into arms and hands.

Dry hands and arms with sterile towel. Hold hands up!

Gown Technique

Method

1. Discard gown method is used.
2. Gown is used once, removed and sent to the laundry.

Summary of preparation for operation[28]

1. The operating room personnel are notified as to the time and nature of the operation.
2. The hospital corpsman in charge of instruments selects those needed and puts them in the sterilizer along with the necessary utensils.
3. The cutting instruments are placed in hot water sterilizer or in a sterilizing solution.
4. All hands assist in placing the furniture and equipment in proper order.
5. The circulating corpsman selects the packages of sterile goods and places them on the proper tables.
6. The scrub corpsmen proceed to scrub up and don sterile gowns and gloves.
7. The scrub corpsmen drape the tables and stands.
8. The trays of sterile instruments are brought in and arranged in proper order on the instrument table. They are then covered with sterile towels until needed.
9. The basin and utensil set is opened and placed in proper places.
10. Additional sterile packages are opened and put in proper places.
11. Sutures and ligatures are prepared.
12. If spinal anesthesia is to be given, tray is prepared by scrub corpsman.
13. All tables and stands containing sterile articles are draped until needed.
14. The patient is wheeled into the operating room and the anesthetic is administered.
15. By this time, the surgeon and his assistant(s) are dressed and scrubbed and ready to be dressed in sterile gowns and gloves by one of the scrub corpsmen.
16. The patient's skin is prepared by the assistant or scrub corpsmen using green soap, ether and merthiolate or other method preferred by the surgeon.
17. The patient is then draped with towels and sheets by the assistant and scrub corpsman.
18. The instrument table (Mayo stand) and double-basin stand are rolled into place.
19. The surgeon, assistant, and corpsman assume their proper places.
20. The corpsman hands the scalpel to the surgeon, the incision is made, after which the skin knife is discarded and the operation proceeds.

[28] Adapted from Hospital Corps Handbook, 1939 edition.

SUGGESTED ADDITIONAL READING—UNIT VI

ALEXANDER, EDYTHE. *Operating Room Techniques.* St. Louis: The C. V. Mosby Co., 1951.

APPENDIX

ABBREVIATIONS AND SYMBOLS

Abbreviations	Meaning
Relating to personnel	
CO	commanding officer.
OOD	officer of the day.
WMO	ward medical officer.
SpW	special watch.
Relating to wards and services	
CD	communicable disease.
CDR or CSR	central dressing or supply room.
EENT	eye, ear, nose and throat.
GU	genito-urinary.
Lab	laboratory.
Mecano	mechanotherapy.
Med	medical.
NP	neuropsychiatric.
OB	obstetrical or maternity.
OR	operating room.
OT	occupational therapy.
Ped	pediatric or children.
Pharm	pharmacy.
PT	physical therapy.
SOQ	sick officers quarters.
Surg	surgical.
TB	tuberculosis.
Wd	ward.
Relating to census	
CLR	census last report.
A	admitted to hospital.
AOW	admitted from other ward.
TOW	transferred to other ward.
D	discharged from hospital.
DD	discharged by death.
Occ	occupied beds.
Vac	vacant beds.
Cap	capacity beds.
L	leave or liberty.
AOL	absent over leave.
PAL	prisoner at large.
CL	critical list.
SL	serious list.
Relating to physical examination	
BP	blood pressure.
L. L. L	left lower lobe.
L. L. Q	left lower quadrant.
L. U. L	left upper lobe.

Abbreviations	Meaning
Relating to physical examination—Continued	
L. U. Q	left upper quadrant.
os	mouth.
o. s	left eye.
o. d	right eye.
P. E	physical examination.
R. L. L	right lower lobe.
R. L. Q	right lower quadrant.
R. M. L	right middle lobe.
R. U. L	right upper lobe.
R. U. Q	right upper quadrant.
T. P. R	temperature, pulse, respiration.
Relating to tests and examinations	
BMR	basal metabolism rate.
BSP	bromsulfalein test.
CBC	complete blood count.
EEG or EECG	electroencephalogram.
ECG or EKG	electrocardiogram.
ESR or Sed rate	erythrocyte sedimentation rate.
GB series	gall bladder series of X-rays.
GI series	gastrointestinal series of X-rays.
Hgb	hemoglobin.
IVP	intravenous pyelogram.
LP	lumbar puncture.
NPN	nonprotein nitrogen.
PSP	phenosulphonphthalein test.
Rbc	red blood cell.
sp. gr	specific gravity.
S. & A	sugar and acetone.
VPC	volume packed cells.
wbc. & diff	white blood cell and differential count.
Relating to medicines	
Amp	ampoul or ampule.
h or sc	hypodermic or subcutaneous.
I. M	intramuscular.
I. V	intravenous.
p. o	by mouth.
p. r	by rectum.

Abbreviations	Meaning
Relating to weights and measures	
āā	of each.
ad. lib	as much as desired.
cc.	cubic centimeter.
dr	dram.
gm.	gram.
gr.	grain.
gtt	drop (drops).
Kg	kilogram or 1.000 grams.
L	liter.
lb	pound.
m. or min	minum.
mg	milligram, 1000th of a gram.
mil. or ml	milliliter, 1000th of a liter.
oz	ounce.
pt	pint.
q. s	sufficient quantity.
qt	quart.
t. or tsp	teaspoon.
T. or tbsp	tablespoon.
Relating to time	
a. c	before meals.
b. i. d	twice a day.
h. s	hour of sleep or at bedtime.
o. d	every day.
o. m	every morning.
o. n	every night.
p. c	after meals.
p. r. n	when necessary.
q1 (2, 3, 4) h	every 1 (2, 3, 4) hours.
q. i. d. or 4 i. d	four times a day.
S. O. S	once if necessary.
stat	at once.
t. i. d	three times a day.
Relating to solutions	
B. A	boric acid solution.
N. S. S. or N. S	normal saline solution.
S. S. E	soap suds enema.
Relating to surgical supplies	
Abd	abdominal pad.
D. S. D	dry sterile dressing.
F sheet	field sheet used to establish sterile field.
4 x 4	gauze dressing folded to 4 x 4 inches.
2 x 2	gauze dressing folded to 2 x 2 inches.

Abbreviations	Meaning
Relating to surgical operation	
O. P	day of operation.
P. O. D	post operative day.
Pre-Op	before operation.
Post-Op	after operation.
Miscellaneous	
c̄	with.
C	centigrade.
DU	diagnosis undetermined.
et	and.
etc	and so forth.
F	fahrenheit.
Fr	french, denotes size of catheter or tube.
s̄	without.

MEDICAL TERMINOLOGY

Purpose: To help the corpsman gain understanding of what he reads in his patients' records and in medical literature.

Suggested method of study

1. Select a new word each day.
2. Look at it; break it down into its parts.
3. Write down what you think it means.
4. Check your answer with the definition in a medical dictionary.

Example

Myocarditis
  myo card itis
    myo—muscle
      card—heart
        itis—inflammation of

Myocarditis: Inflammation of the muscles of the heart.

PREFIXES

Pertaining to the body

brach	arm.
capit	head.
cardi	heart.
cholecyst	gallbladder.
cyst	bladder.
derma	skin.
entero	intestines.
glosso	tongue.
gastro	stomach.
hemo	blood.

Pertaining to the body—Continued

hepat	liver.
laparo	abdomen.
myo	muscle.
nephro	kidney.
neuro	nerve.
ophthalmo	eye.
oto	ear.
osteo	bone.
oral	mouth.
pharyn	throat.
phleb	vein.
pneumo	lung.
procto	rectum.
rhino	nose.
thoracic	chest.

Pertaining to conditions

a- or an	lacking, absence of.
auto	self.
ante	before.
anti	against.
contra	against, opposed to.
dys	difficult, painful.
endo	within.
hemi	half.
hydro	water.
hyper	above, increase, in excess.
hypo	below, under.
mal	faulty, poor.
neo	new.
oligi	scanty, few.
poly	too many, too much.
pyo	pus.
pyro	heat, temperature.

SUFFIXES

Pertaining to conditions of the body

-algia	pain.
-cele	tumor, hernia.
-clysis	a slow injection of a large amount of fluid.
-emia	blood.
-esthesia	sensation.
-itis	inflammation.
-lith	stone, calculus.

Pertaining to conditions of the body—Con.

-mania	insanity.
-oma	morbid condition, tumor.
-opia	vision.
-pathy	disease.
-phobia	fear, or dread.
-plegia	paralysis.
-pnea	breathing.
-ptosis	falling.
-rrhea	flow, discharge.
-scopy	visual examination, looking into.
-therapy	treatment.
-thermy	heat.
-trophic, trophy	growth, nutrition.
-uric, uria	urine.

Pertaining to surgical operations

-ectomy	removal of.
-plasty	to form, or build up.
-pexy	to fasten.
-(o) stomy	creation of an opening.
-(o) tomy	cutting into.
-(o) rrhaphy	repair of.
-manometer	used to measure pressure.
-meter	used to measure.
-scope	used to examine by looking into, or by hearing.

EXAMPLES FOR PRACTICE

1. Anemia.
2. Anesthesia.
3. Appendectomy.
4. Atrophy.
5. Blepharitis.
6. Cholelithiasis.
7. Claustrophobia.
8. Colostomy.
9. Cystotomy.
10. Dyspnea.
11. Endoscope.
12. Enteroptosis.
13. Glossitis.
14. Gonorrhea.
15. Herniorrhaphy.
16. Hydrotherapy.
17. Hypertrophy.
18. Hypodermoclysis.
19. Myoma.
20. Nephropexy.
21. Neuralgia.
22. Polyuria.
23. Psychopathic.
24. Pyromania.
25. Rectocele.
26. Sphygmomanometer.
27. Stethoscope.
28. Thermometer.
29. Thoracoplasty.
30. Veneclysis.

SOME SYMPTOMS TO BE OBSERVED AND TERMS TO USE IN RECORDING THEM

Concerning	Observation	Term to use
Abdomen	1. Hard, boardlike.	1. Hard, rigid.
	2. Soft, flabby.	2. Relaxed, flaccid, soft.
	3. Hurts when touched.	3. Sensitive to touch.
	4. Appears swollen, rounded.	4. Protuberant.
	5. Filled with gas.	5. Distended, tympanites.
Areas		1. Epigastric.
		2. Right lumbar.
		3. Umbilical.
		4. Left lumbar.
		5. Right iliac.
		6. Hypogastric.
		7. Left iliac.
Amounts	1. Large amount:	
	of drainage.	Profuse, copious, free.
	of urine.	Polyuria (measure in cc.).
	of defecation.	Copious.
	of emesis.	Measured amount in cc.
	2. Medium amount:	
	of drainage.	Moderate, usual.
	of urine.	Measured amount in cc.
	of defecation.	Moderate.
	of emesis.	Measured amount in cc.
	3. Small amount:	
	of drainage.	Small amount, scanty, slight, very little.
	of urine.	Scanty (measured) in cc.
	of defecation.	Small amount.
	of emesis.	Measured amount in cc.
Appetite	1. Very fussy about food, refuses to eat many foods.	1. Has definite likes and dislikes about food.
	2. Eats all foods served.	2. Appetite good.
	3. Eats very little.	3. Appetite poor.
	4. Loss of appetite.	4. Anorexia.
	5. Craving for certain foods.	5. List foods.
	6. Refuses to eat.	6. Refused food (state reason).
Arm	1. Shoulder to elbow.	1. Upper arm (right or left).
	2. Elbow to wrist.	2. Lower arm (right or left).
Back (areas)	1. Upper back.	1. Inter-scapular shoulder region.
	2. Small of back.	2. Lumbar region.
	3. End of spine.	3. Sacral region.
	4. Gluteal region.	4. Buttocks.
Baths	1. Given when patient is admitted.	1. Admission bath.
	2. All inclusive bath.	2. Complete bath.
	3. Including: face, arms, back, axilla, and genitals.	3. Partial bath.
	4. Special baths (treatments).	4. Name of bath (alcohol sponge, Sitz, etc.).
Belch	Belching.	Eructation.
Bleeding	1. Spurting of blood.	1. In spurts.
	2. Very little.	2. Oozing.
	3. Nosebleed.	3. Epistaxis.
	4. Blood in vomitus.	4. Hematemesis.
	5. Blood in urine.	5. Hematuria.
	6. Spitting of blood.	6. Hemoptysis.
	7. When bleeding is stopped.	7. Hemorrhage controlled.
	8. Color.	8. Bright red, dark red, frothy.
Blister	Blister.	Vesicle.
Blood pressure	Blood pressure 120/74.	B. P. 120/74.
B. M. R.	Basal metabolism rate.	B. M. R.
Breath	1. Unpleasant.	1. Halitosis.
	2. Foul odor.	2. Foul.
	3. With sweet fruitlike odor.	3. Fruity.

SOME SYMPTOMS TO BE OBSERVED AND TERMS TO USE IN RECORDING THEM—Con.

Concerning	Observation	Term to use
Breathing	1. Breathing.	1. Respiration.
	2. Act of inhaling.	2. Inspiration.
	3. Act of exhaling.	3. Expiration.
	4. Difficult breathing.	4. Dyspnea.
	5. Short periods when breathing has ceased.	5. Apnea.
	6. Inability to breathe lying down.	6. Orthopnea.
	7. Normal breathing.	7. Eupnea.
	8. Rapid breathing.	8. Hyperpnea.
	9. Increasing dyspnea with periods of apnea.	9. Cheyne-Stokes respiration.
	10. Snoring, breathing.	10. Stertorous respiration.
	11. Large volume of air inspired or expired.	11. Deep breathing.
	12. Small volume of air inspired or expired.	12. Shallow breathing.
	13. Abnormal variation in rhythm.	13. Irregular respiration.
Care	1. Oral hygiene, bedpan, face and hands sponged.	1. Early a. m. care.
	2. Oral hygiene, bedpan, bath, care of hair and nails, alcohol back rub.	2. Complete bath.
	3. Oral hygiene, bedpan, face and hands sponged, alcohol back rub.	3. P. M. care.
	4. Special attention or treatment.	4. Special care to back, mouth, etc.
Chill	1. Blanket applied to help warm the patient.	1. External heat applied.
	2. Type as to severity.	2. Severe, moderate, slight.
	3. Duration.	3. Lasting number of minutes.
Coma	1. Partly in coma.	1. Partially comatose.
	2. Deep in coma.	2. Profound comatose.
Convulsion	1. Continuous shaking.	1. Duration and description.
	2. Shaking with intervals of rest.	2. Duration and description.
	3. Begin without warning.	3. Sudden onset.
Cough	1. Coughs at all times.	1. Continuous cough.
	2. Coughing over a long period of time.	2. Persistent cough.
	3. Coughs up material.	3. Productive cough, describe.
	4. Short, hard cough.	4. Hacking cough.
Defecation	1. Bowel movement material.	1. Feces, stool.
	2. Bowel movement (act of).	2. Defecation.
	3. Excessive defecation.	3. Diarrhea, describe.
	4. Gray colored stool.	4. Clay colored liquid stool.
	5. Dark brown liquid stool.	5. Highly colored liquid stool.
	6. Formed, yet soft stool.	6. Soft formed stool.
	7. Formed with hardened stool.	7. Hard formed stool.
	8. Infrequent bowel movements.	8. Constipation.
	9. Black stool.	9. Black, tarry stool.
Dizziness	Dizziness.	Vertigo.
Drainage	1. Watery, from nose.	1. Coryza.
	2. Containing pus.	2. Purulent.
	3. Bloody.	3. Sanguinous.
	4. Consists of feces.	4. Fecal.
	5. Of serous fluid.	5. Serous.
	6. Containing mucus and pus.	6. Mucopurulent.
	7. Tough, sticky.	7. Tenacious.
	8. From vagina (after delivery).	8. Lochia.
Dressings	1. A second dressing added to the first.	1. Dressing reinforced.
	2. Dressing removed, another applied.	2. Redressed.
	3. Drain tubes cut off.	3. Drain tubes shortened (number of inches).
	4. Drain taken out.	4. Drain removed.
Drop	A drop or drops.	Gtt.

SOME SYMPTOMS TO BE OBSERVED AND TERMS TO USE IN RECORDING THEM—Con.

Concerning	Observation	Term to use
Emesis	1. Produced by effort of patient. 2. Ejected to a few feet distant. 3. If blood is only noticeable. 4. Material vomited. 5. Contents.	1. Induced. 2. Projectile. 3. Blood tinged. 4. Vomitus, emesis. 5. Describe color, odor, appearance, consistency.
Eyes	1. Sharpness of vision. 2. Yellow in color. 3. Puffy. 4. Motionless. 5. Sensitive to light. 6. Double vision. 7. Squinting. 8. Abnormal protrusion of eyeball. 9. Inflammation of conjunctiva.	1. Visual acuity. 2. Jaundiced. 3. Edematous. 4. Staring. 5. Photophobia. 6. Diplopia. 7. Strabismus. 8. Exophthalmos. 9. Conjunctivitis.
Faint	Fainting.	Syncope.
Fever	1. Without fever. 2. Temperature above normal. 3. Temperature greatly above normal. 4. Temperature suddenly returns to normal. 5. Temperature gradually returns to normal.	1. Afebrile. 2. Pyrexia. 3. Hyperpyrexia. 4. Crisis. 5. Lysis.
Gas	1. Gas in the digestive tract. 2. Having gas in the digestive tract. 3. Swelling of abdomen.	1. Flatus. 2. Flatulence. 3. Distention.
Gums	Inflammation of the gums.	Gingivitis.
Hallucination	1. Of hearing. 2. Of sight. 3. Of smell. 4. Of taste.	1. Auditory hallucination. 2. Visual hallucination. 3. Olfactory hallucination. 4. Gustatory hallucination.
Hands	1. Dirty, rough, nails broken. 2. Abnormally large.	1. Shows lack of care. 2. Massive.
Head	1. Forehead. 2. Region over temple. 3. Back of head. 4. Base of skull.	1. Frontal region. 2. Temporal region. 3. Occipital region. 4. Basilar region.
Hives	1. Hives. 2. Itching.	1. Urticaria. 2. Pruritis.
Joints	1. Bending. 2. To straighten. 3. Turn inward. 4. Turn outward. 5. Revolve around. 6. Move away from median line. 7. Move toward median line.	1. Flexion. 2. Extension. 3. Inversion. 4. Eversion. 5. Rotation. 6. Abduction. 7. Adduction.
Legs	1. Thigh to knee 2. Knee to ankle.	1. Upper leg (right or left). 2. Lower leg (right or left).
Lice	1. Head, body, pubic. 2. Condition of lousiness.	1. Pediculi. 2. Pediculosis.
Mental attitude	All statements on charts concerning attitudes must have "appears" "seems," or "apparently" before them. These are the observer's interpretations of what he thinks he sees. Only the patient knows for sure what his attitude is.	
	1. Hard to please. 2. Distrustful. 3. Happy. 4. Sad. 5. Afraid. 6. Over religious. 7. Lacks emotional control. 8. Loss of memory.	1. Irritable, fault-finding. 2. Distrustful, suspicious. 3. Optimistic, cheerful. 4. Depressed, moody. 5. Apprehensive, anxious. 6. Deeply religious. 7. Hysterical. 8. Amnesia.

SOME SYMPTOMS TO BE OBSERVED AND TERMS TO USE IN RECORDING THEM—Con.

Concerning	Observation	Term to use
Nourishment	1. Very small amount of water. 2. Small pieces of ice. 3. Drink of water. 4. Given through tube into stomach. 5. Given by enema.	1. Sips water. 2. Chipped ice. 3. Water (number of cc.). 4. Gavage. 5. Nutritive enema, fluid and amount.
Odor	1. Not unpleasant. 2. Like fruit. 3. Very unpleasant. 4. Belonging to particular drug, etc. 5. Like feces.	1. Aromatic. 2. Fruity. 3. Offensive. 4. Characteristic. 5. Fecal.
Pain	1. Great pain. 2. Little. 3. Period of great pain followed by period of little or no pain. 4. Spreads to distant areas. 5. Started all at once. 6. Hurts worse when moving.	1. Severe. 2. Slight. 3. Paroxysmal. 4. Radiating. 5. Sudden onset. 6. Increased by movement.
Paralysis	1. Of the muscles of the face. 2. Of the legs. 3. Of one side of body. 4. Of a single limb. 5. Both arms and legs.	1. Facial. 2. Paraplegia. 3. Hemiplegia. 4. Monoplegia. 5. Quadriplegia.
Patient (admission of)	1. Walking. 2. Carried (infant). 3. By wheelchair. 4. By stretcher. 5. Had a bedsore when admitted.	1. Ambulatory. 2. In arms. 3. Per wheelchair. 4. Per stretcher. 5. Decubitus ulcer present on admission; describe size and appearance.
Perspiration	1. Large amount. 2. Small amount.	1. Profuse diaphoresis. 2. Scanty.
Pulse	1. Number of beats per minute. 2. Rhythm. 3. Beats missed at intervals. 4. Over 100 beats per minute. 5. Very rapid, beats indistinct. 6. Slow in rate. 7. One scarcely perceptible. 8. Small, rapid and tense.	1. Rate. 2. Regular or irregular. 3. Intermittent. 4. Rapid. 5. Running. 6. Slow. 7. Thready. 8. Wiry.
Reproductive organs	External reproductive organs.	Genitalia (external).
Respiration	See breathing.	
Restraint	1. Boards put on bed. 2. Tied down with sheet. 3. Fastened to bed with ankle strap (right).	1. Sideboards applied. 2. Sheet restraint applied. 3. Right ankle strap applied.
Rings	1. Rubber ring to relieve pressure. 2. Cotton rings applied under heels, elbows, etc.	1. Placed on rubber ring. 2. Cotton ring applied to each heel, elbow, etc.
Skin	1. Normal. 2. Pink, hot. 3. Blue in color. 4. Very white. 5. Shines. 6. Raw surface. 7. Yellow in color. 8. Torn. 9. Containing colored areas. 10. Wet. 11. Scraped. 12. Black and blue mark. 13. Cold, clammy.	1. Healthy. 2. Flushed. 3. Cyanotic. 4. Extreme pallor. 5. Glossy. 6. Excoriation. 7. Jaundiced. 8. Lacerated. 9. Pigmented. 10. Moist. 11. Abraded. 12. Ecchymosis. 13. Cold, clammy.

SOME SYMPTOMS TO BE OBSERVED AND TERMS TO USE IN RECORDING THEM—Con.

Concerning	Observation	Term to use
Sleep	1. Slept very little. 2. Tired when wakens. 3. Moans while sleeping. 4. Inability to sleep.	1. Slept very little or slept at short intervals. 2. Awakens fatigued. 3. Sleep disturbed-moaning. 4. Insomnia.
Smoke	Smokes too much.	1. Smokes excessively.
Unconsciousness	1. Complete unconsciousness. 2. Partial unconsciousness. 3. Pretended unconsciousness.	1. In comatose condition. 2. In stuporous condition. 3. Feigned unconsciousness.
Urination	1. To urinate. 2. No control over urination. 3. Burning when voiding. 4. Large amount of urine voided. 5. Total suppression of urine. 6. Frequent voiding at night. 7. Painful urination. 8. Pus in urine. 9. Blood in urine. 10. Hemoglobin in urine. 11. Glucose in urine. 12. Albumin in urine. 13. Acetone in urine. 14. Bile in urine. 15. Scantiness of urine. 16. Sugar in the urine.	1. Void, micturate. 2. Involuntary, incontinent. 3. Burning sensation on micturition. 4. Polyuria. 5. Anuria. 6. Nocturia. 7. Dysuria. 8. Pyuria. 9. Hematuria. 10. Hemoglobinuria. 11. Glucosuria. 12. Albuminuria. 13. Acetonuria. 14. Choluria. 15. Oliguria. 16. Glycosuria.
Vomit	Desire to do so (for various types, see Emesis).	Nausea.
Weight	1. Overweight. 2. Thin, underweight.	1. Obese. 2. Emaciated.
Wounds	1. Deep. 2. Slight, surface only. 3. Not infected. 4. Discharging pus. 5. Infected. 6. Torn.	1. Deep. 2. Superficial. 3. Clean. 4. Suppurating. 5. Infected. 6. Torn.

Chapter V

FOOD IN HEALTH AND DISEASE

DIET IN HEALTH

Food is a potent weapon of warfare; it wins wars and keeps the peace and good will of nations. The happiness of a people depends on radiating health and vitality, which good food can bring. Remember, "You are what you eat."

Functions of Foods

Foods furnish materials needed to:

1. Build new tissue.
2. Maintain and repair tissue.
3. Regulate body processes.
4. Give energy.

Food Composition

Foods are composed of carbohydrates, fats, proteins, vitamins, minerals, and water.

Carbohydrates furnish energy. Best sources: flour (bread, cakes, pastry), spaghetti, macaroni, rice, and other cereals, sugars and syrups.

Fats furnish energy; many fats also serve as carriers—that is, food sources of the fat-soluble vitamins, vitamin A, vitamin D, vitamin E, and in some cases vitamin K. Best sources: butter, margarine fortified with vitamin A, and oils.

Proteins furnish essential building and repairing materials for muscles and tissues of the body. They also furnish energy. Protein from animal sources in general is superior to protein from vegetable sources. Best sources: milk, eggs, meat, fish, and poultry. Other sources: dried peas and beans, cereals, and vegetables.

Vitamins are chemical substances present in food in minute quantities. They are necessary for growth and the maintenance of normal body functions.

Vitamin A.—The functions of vitamin A include: (1) to maintain general health; (2) to promote growth; (3) to maintain normal vision, especially in dim light; (4) to promote resistance to infection. Best sources: butter, liver, egg yolk, cheese, fish liver oils, yellow and green vegetables, and fruits.

Vitamin B[1] (Thiamine).—The functions of this vitamin are (1) to maintain appetite; (2) to maintain good muscle tone; (3) to regulate normal functioning of the nervous system; (4) to prevent fatigue. Best sources: liver and kidney, lean meat, especially pork, peas, and beans.

Riboflavin (Vitamin B_2 or G).—This vitamin is essential to growth and well-being. In conjunction with other B-complex vitamins, it functions in the chemical processes of cell respiration. Deficiencies may result in digestive disturbances, nervous depression, general weakness, and poor conditions of the eyes and skin. Best sources: milk, lean meat, eggs, liver, green vegetables, peas, and beans.

Niacin (Nicotinic Acid).—This vitamin prevents the deficiency disease called pellagra. Best sources: liver, lean pork, salmon, whole grain cereals and enriched flour, milk, and eggs.

Vitamin C (Ascorbic Acid).—This vitamin (1) prevents scurvy; (2) maintains the health of teeth and gums; (3) aids in resistance to infections; (4) prevents listlessness and fatigue; (5) maintains strength of the bony structure and the walls of the blood vessels. Best sources: citrus fruits, raw vegetables, fresh fruits and fruit juices, tomatoes (raw and canned). Other sources: green vegetables and potatoes, if not overcooked.

Vitamin D.—The function of vitamin D is to help regulate the use of calcium and phosphorus in the development of the bones and teeth. Best sources: fish liver oils, egg yolk, liver, and irradiated food. Sunshine affects the skin in such a way as to produce vitamin D, which is utilized in the same manner as vitamin D from food.

Vitamin K.—This vitamin acts to maintain the normal level of prothrombin (clotting material) in the blood. Best sources: alfalfa, spinach, cabbage, cauliflower, and soybean oil.

Minerals

Certain mineral elements are needed by the body for growth and maintenance of body structure and processes. Some of these are so widely distributed in foods that they are usually supplied in sufficient amount in any diet. However, since calcium and iron may be too low unless care is taken in food selection, we should consider them at greater length.

Calcium.—When combined with phosphorus, it furnishes the material from which bones and teeth are built, aids in the clotting of blood, and in regulating the action of nerves and muscles. Best sources: milk (whole or skim), cheese. Other sources: leafy vegetables, molasses, dried beans, or soybeans.

Iron.—This mineral is required for the formation of the coloring matter of the red blood cells. Best sources: eggs, meat, molasses, green vegetables, dried fruits, dried beans, whole grain cereals, and enriched flour.

Caloric Values of Food

An important function of food is to supply energy. Energy value of food is referred to as the caloric value. In food chemistry the unit used to measure the caloric value of food is the large calorie. The large calorie is the amount of heat necessary to raise the temperature of one kilogram of distilled water one degree centigrade. By the use of calorimeters, the caloric value for the different classes of foods have been determined to be:

1 gram of protein yields 4 calories.
1 gram of fat yields 9 calories.
1 gram of carbohydrate yields 4 calories.

The matter of providing a sufficient source of energy-supplying foods is seldom a problem in American dietaries and never a problem (except in isolated emergencies) in the proper nutrition of naval personnel. The availability of soft beverages, candy, and other sweets and the natural inclination of most persons to consume these take care of this point. It is, nevertheless, interesting to know something about such requirements and the extent to which foods vary in their ability to meet such requirements.

Tables have been prepared which show the approximate caloric values of a variety of foods; a few typical examples follow:

	Calories
1 average serving of fresh beans	19
1 teaspoon of butter	37
1 average serving of steak or hamburger	200
1 medium egg	71
1 medium banana	99
Peanuts (small package)	210
1 small sweet roll	213
1 piece mince pie	685

The fuel or energy requirements of an individual vary widely, depending upon the nature of his activity. This requirement can also be measured in terms of his oxygen consumption under various conditions and can be also expressed in calories. The energy requirements of a normal 154-pound man under different activity conditions vary, in general, as follows:

Form of activity	Calories per hour
Sleeping	65
Awake lying still	77
Standing at attention	115
Typewriting rapidly	140
Sweeping bare floors (38 strokes per minute)	169
Walking slowly (2.6 miles per hour)	200
Carpentry, metal working, industrial painting	240
Walking moderately fast	300
Sawing wood	480
Swimming	500
Running (5.3 miles per hour)	570
Walking upstairs	1,100

The probable energy requirements for one day of a 154-pound individual doing physical work may be estimated as follows:

	Calories
8 hours of sleep (65 calories per hour)	520
3 hours of light exercise such as going to and from work (170 calories per hour)	510
8 hours of shipside painting (240 calories per hour)	1,920
5 hours of sitting at rest (100 calories per hour)	500
Total for the day	3,450

To maintain body weight without loss or gain, this individual would have to consume food in amounts and kind to yield 3,450 calories. Since we have assumed this man to be a normal individual, if he consumed more, he would gain weight; if he consumed less he would lose weight, unless some disease condition or glandular imbalance prevailed which interfered with his proper utilization of the food eaten. This balancing of food intake against energy requirement is the only sane

basis of weight control for most of us, and this can only be done safely with the maintenance of a balanced diet which assures adequate amounts of all essential nutrients.

Adequate Balanced Diet

An adequate balanced diet should contain:

1. Carbohydrates and fats sufficient to yield the energy for (*a*) internal activities of the body essential to life; (*b*) the external work to be done.

2. Protein sufficient for growth and maintenance of body cells.

3. Minerals in adequate amounts for growth and maintenance of bones and teeth, and to regulate body processes.

4. Vitamins of the right kind and in the right amount for regulation of body processes.

5. Water.

Following is a good guide, which may be helpful in choosing an adequate diet:

INCLUDE ONE OR MORE FROM EACH OF THE BASIC FOODS EACH DAY

Basic foods	Recommended daily	Nutrition highlights
Milk and milk products: Fresh fluid, evaporated or dehydrated milk, and cheese.	1 pint liquid or equivalent. 1 quart for children.	Milk furnishes protein of good quality, high content of vitamins, A, G (riboflavin), and considerable B_1 (thiamine). Cheese: 5 ounces of American cheddar cheese is about equal to 1 quart of milk in calcium, phosphorus, and protein content.
Eggs: Fresh, frozen, or dehydrated	1 egg	Eggs are especially valuable for their complete proteins, iron, phosphorus, and vitamin A.
Butter	1 to 2 ounces	Butter is especially valuable for its vitamin A and fat content.
Meat, fowl, fish: Fresh, frozen, or canned.	1 or more servings of meat, fish or fowl.	Meat furnishes complete proteins, phosphorus, iron B_1 (thiamine), and G (riboflavin). Liver is especially high in vitamin A. Fish are important for protein, phosphorus. Salt water fish furnish iodine.
Legumes: Dried kidney, lima, and navy beans; dried peas; also peanut butter.	Once or twice a week	Legumes are chiefly important as a source of energy, protein, phosphorus, iron, thiamine. Because they are not a source of complete proteins, legumes should be used only as a supplement and not as a total substitution for animal proteins.
Cereals and bread: Cereals, whole grain or restored to whole grain value.	2 or more servings	Cereals with whole grain value, and enriched bread, furnish energy, protein, bulk, iron, phosphorus, and vitamins B_1, G.
Fruits: Fresh, frozen, canned, dried, or dehydrated.	2 or more servings, 1 fresh fruit when possible. Citrus fruit often.	Fruits supply vitamins, minerals and bulk. Citrus fruits are high in vitamin C. Yellow fruits supply generous amounts of vitamin A.
Vegetables: Fresh, frozen, canned, dried, or dehydrated.	2 or more servings besides potatoes. 1 green or yellow vegetable each day. Serve tomatoes and greens, cooked or in salads often.	Vegetables furnish valuable vitamins, minerals and bulk. Green and yellow vegetables are valuable for vitamin A and iron. Use the outer dark green leaves of lettuce and cabbage in salads and soups. To save nutrients, use water in which vegetables are cooked for soups, and gravies. Tomatoes, fresh or canned, are especially valuable for their vitamin C. Use them often, fresh or canned.

NOTE.—Other foods in form of desserts, syrups, and sugar, may be used to supplement the diet. Sugar supplies energy but makes no other dietary contributions.

The maintenance of an adequate balanced diet is a matter that cannot be left to chance. Bear in mind a few simple guides:

1. Refrain from eating candy, cake, and sweets—substitute fruits, nuts, and ice cream.

2. Avoid as much as possible the white bleached flour and "processed" cereals—substitute whole-grain products.

3. Reduce your consumption of sugar-loaded soft drinks—substitute milk.

4. Eat all the green and yellow vegetables and fruit you reasonably can, and eat at least one-third of these raw, except in those situations where sanitary considerations might make them dangerous.

DIET IN DISEASE

Therapeutic Diets

A well-balanced diet, which is necessary to maintain good nutrition and which has been outlined in the foregoing, is the basic principle of all dietary prescriptions. Modifications can then be made to suit the various needs of the body in disease. Many times this can be done by making one or two changes in the General Mess ration.

Objectives of Dietary Treatment

1. To increase or decrease body weight.
2. To rest a particular organ, as when fat is reduced in diseases of the liver.
3. To adjust the diet to the ability of the body to use certain foods, as in diabetes mellitus.
4. To produce some specific effect as a remedy: for example, a high acid ash state in certain urologic diseases.
5. To overcome deficiency states by the addition of foods rich in some necessary element, such as vitamin C in scurvy.
6. To provide "ease of digestion" by omitting irritating substances, such as fiber, condiments, and fried foods.

Principles of special diets prescribed for some specific diseased states are described below.

Acute Fevers

1. A liquid diet, adjusted somewhat to the patient's appetite, will be sufficient through the acute state.
2. Later the caloric and protein intake are increased, as the patient is returned to a normal diet.

Sub-Acute Fevers (Such as Typhoid)

1. Soft and liquid foods are given at frequent, regular feedings.
2. The diet is high in calories and in protein (milk and eggs).
3. The diet is high in carbohydrate and fat. (Cream, butter, and egg yolk are best.)

Chronic Fevers (Such as Tuberculosis)

1. Caloric value is slightly above normal.
2. Relatively high protein, especially milk, is given.
3. Fat is somewhat higher than normal; in easily digested form (cream, butter, and egg yolk).
4. A diet high in calcium and thiamine; vitamins C and D are given.
5. Nourishment is given between meals and after retiring.

Gout

1. Since gout is a disturbance of the purine metabolism, a diet in low purine is given.
2. **During attacks** all purine-containing foods are avoided. These are meat, fish, fowl, game, shellfish, asparagus, beans (kidney, lima, and navy), lentils, mushrooms, peas, and spinach.
3. During remissions, on 5 days a week, 2 ounces of meat, fish, or fowl (except glandular meats, meat extractives, broths, gravies, anchovies, roe, and sardines, which must be avoided entirely) or one-half cup of vegetables—asparagus, beans (kidney, lima, navy), lentils, mushrooms, peas, and spinach—may be taken.
4. The diet may be deficient in protein, iron, and thiamine; thus on meat-free days, five eggs daily or substitute cheese (such as American or cottage cheese), and milk are important.
5. Excessive use of fats should be avoided.

Anemia

1. A diet high in iron is given in iron deficiency anemias.
2. Any foods, with emphasis on the high iron ones may be taken.
3. Iron-containing foods include: (*a*) Milk and milk products, especially malt flavored; (*b*) whole grain breads and cereals; (*c*) dried fruit and nuts; (*d*) molasses and brown sugar; (*e*) meat, especially glandular meats and oysters; (*f*) dried beans and dried peas; (*g*) green beet greens, chard, dandelion greens, kale, spinach, and turnip greens; (*h*) peanut butter.
4. Dried brewer's yeast will increase the iron content.

Obesity

1. For weight reduction, a diet containing adequate protein, some carbohydrate foods, and a minimum of fats is given.

2. Foods allowed include: (*a*) Meat, eggs, cheese, and milk (skimmed or buttermilk on diets of 1,000 calories or less); (*b*) bread in amounts specified for various calorie levels (one thin slice on the 800-calorie diet; three thin slices on the 1,000-calorie diet); (*c*) fruits, fresh or canned without sugar; (*d*) butter, one teaspoon on the 800-calorie diet; three teaspoons on the 1,000-calorie diet; (*e*) clear broth or bouillon; and (*f*) vegetables, except the higher carbohydrate ones, such as potatoes, corn, lima beans.

3. Foods to be avoided are: Fatty meats, salad dressings, nuts, cream, butter (except as allowed on the diet), fried foods, pastries, sugar, candy, jellies, jams, honey, hot breads, coffee cake, hot cakes, sweet rolls, waffles, cakes, cookies, puddings, avocados, dried fruits, dried beans and peas, potatoes, corn and lima beans, alcohol, carbonated beverages, catsup, chili sauce, gravy, nuts, olives, pickles, and relish.

4. Since there may be a deficiency of vitamins on a restricted diet, a vitamin supplement is usually given on the lower calorie levels.

Underweight

1. Patients who are underweight or who need a high caloric intake because of fever, increased metabolic rate, or poor absorption due to diarrhea are given a diet of 3,000 to 3,500 calories or more.

2. High-calorie foods are emphasized; these include cakes, cookies, ice cream, pie, puddings, butter, cream, oil, salad dressing, candy, jelly, sugar, gravy, and nuts.

3. Food should be taken at regular meal times, in the quantity specified by the dietitian. In-between meal eating should be avoided, since the appetite may be dulled for the next meal.

4. Resting after meals, when possible, is desirable.

Peptic Ulcer

1. Frequent feedings are desirable to take up the free hydrochloric acid and also provide sufficient nourishment without overtaxing the stomach.

2. Protein foods, such as milk and eggs, are given to combine with the free hydrochloric acid present in the stomach.

3. Cream, rich in fat, is useful because of its inhibitory effect on gastric secretion and also because of its high caloric value.

4. All foods should be of moderate temperature and as soft and smooth as possible in order that there will be no mechanical irritation from rough fibers or harsh seeds and skins. When vegetables and fruits are added to the diet, the ones allowed are peas, beets, carrots, pumpkin, spinach, string beans, squash, ripe banana, avocado, baked, canned, or stewed apples, apricots, cherries, peaches, pears, pureed dry fruits, and diluted orange juice.

5. All foods that stimulate gastric secretion, such as meats and meat extractives (broths or gravies), acid fruits, coffee, tea, caffeine-containing carbonated beverages, and alcohol should be either limited or entirely excluded.

6. Foods which may be chemically irritating, such as excessively sweet, acid, salty or spicy foods, should be eliminated.

7. Since the diet is limited in fresh fruits and vegetables, a vitamin supplement is usually prescribed.

Gallbladder

1. Fried foods are restricted.

2. Foods which commonly cause gaseous distention, such as dried beans, broccoli, brussels sprouts, cabbage, cauliflower, cucumbers, kohlrabi, onions, dried peas, green peppers, radishes, rutabagas, sauerkraut, turnips, raw apples, and melons may be restricted in some cases. These foods may be tried one at a time and be included as tolerated.

3. Fat may be restricted in diets of patients who exhibit an intolerance for it.

Liver

1. The diet is high in calories with emphasis on protein and carbohydrate rather than fat.

2. Fat is kept low as is necessary for a palatable diet. Preferred fats in liver diets are egg yolk, milk, and cream in limited amounts.

Colostomy

1. A low residue diet, which contains fewer servings of fruits and vegetables, is given.
2. Milk is omitted to begin with, except as is used in cooking. Boiled milk is added and later whole milk is tolerated.
3. All foods should be soft and smooth. For example, refined cereals are used. Less tender meats are omitted.
4. The fruits allowed include canned or cooked apples, apricots, cherries, peaches, pears, strained dried fruits, all without skin or seeds; and strained fruit juices.
5. Strained vegetables and tomato juice are allowed.
6. Fried foods and rich desserts are omitted.
7. Since the diet is limited in fresh fruits and vegetables, a vitamin supplement is indicated.

CLASSIFICATION OF DIETS

The diets served in naval hospitals usually are liquid, soft, light, regular, and special diets.

Liquid diets are usually ordered as "clear liquid" or "full liquid." A clear liquid diet includes clear broths, rice and barley water, black tea or coffee, jello, and strained fruit juices. A full liquid diet includes all liquids served in a clear liquid diet with the addition of strained soups, strained gruels, milk and milk drinks, ice cream, and junket.

Soft diet includes all liquids in addition to well-cooked cereals, Italian pastes, white bread and crackers, soft-cooked eggs, cottage cheese, soft cream cheese, tender fish, chicken, minced tender lamb and beef, sweetbreads, and brains. Baked, mashed, escalloped, and creamed potatoes, and pureed vegetables are also given on a soft diet. The desserts used are custards, gelatin puddings, simple cakes and cookies, cooked fruits without seeds or heavy fiber, and ripe bananas.

Light diet includes all articles given in the soft diet as well as prepared cereals, whole-wheat bread, creamed or grated cheese, steaks, chops, bacon, tender roast lamb or beef, fish and liver. The vegetables allowed, not pureed, are asparagus, peas, string beans, spinach, carrots, beets, squash, tomatoes, and lettuce. All cooked fruits, citrus fruits, olives, and mayonnaise are allowed. Regular diet is the diet served to the general mess.

Special diets include the Sippy, Karell, and other special dietaries which are indicated in some particular diseases and which are prescribed by the medical officer for some particular case.

Sample Liquid Diet

The following is a sample of a liquid diet that may be easily prepared aboard ship or any small station. This is intended only as a guide.

Breakfast

Strained fruit juice.
Strained cereal gruel.
Milk.
Coffee or tea with cream and sugar, if desired.

Noon

Strained cream soup.
Strained fruit juice.
Coffee or tea with sugar and cream, if desired.
Milk.
Ice cream, plain vanilla or chocolate.

Supper

Strained soup or broth.
Strained fruit juice.
Hot chocolate.
Baked custard.

Sippy Diet

Following is an outline of the sippy diet as used at the U. S. Naval Hospital, Bethesda, Md. This diet will vary with different conditions, and on the advice of the medical officer.

This diet is for 28 days and has been broken into numbers 1 through 5 for convenience of centralized meal service in hospitals:

First through fifth day

Sippy No. 1

Four ounces of milk and cream, equal parts, every hour from 0700 to 2100.

Two ounces orange juice, diluted, daily 0700.

Sixth through eighth day

Sippy No. 2

Four ounces milk and cream, equal parts, every hour from 0700 to 2100.

Strained cooked cereal, one bowl, at 0730, daily.

Two ounces orange juice, diluted, at 0730, daily.
Strained cream soup, one bowl, at 1130, daily.
Baked custard (egg or plain pudding), one custard cup at 1630, daily.

Ninth through twelfth day

Sippy No. 3

Three ounces milk and cream, equal parts, every hour from 0700 to 2100.
Two ounces orange juice, diluted, 0730.
Strained cooked cereal, one bowl, 0730.
Two soft cooked eggs, 0730.
Toast and butter, 0730.

1130

Strained cream soup, one bowl.
Bland potato.[1]
Toast and butter.

1630

Bland potato.[1]
Custard or plain pudding.
Toast and butter.

Thirteenth through twentieth day

Sippy No. 4

Two-thirds glass milk with one-third glass cream at 0900, 1300, 1500, and 2100.

0730

Milk, 1 glass.
Two ounces orange juice, diluted.
Strained cooked cereal, one bowl.
Toast and butter.
Bland fruit.[2]

1130

Strained creamed soup, one bowl.
Bland potato.[1]
Toast and butter.
Bland fruit.[2]
Milk, 1 glass.

1630

Creamed soup, strained, one bowl.
Bland potato.[1]
Custard.
Toast and butter.
Milk, one glass.

[1] Bland potato may be baked, boiled, mashed, creamed, or escalloped.
[2] Bland fruit consists of canned pears, peaches, applesauce, or strained cooked dried fruits.

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Twenty-first through twenty-eighth day

Sippy No. 5

0730

Two ounces orange juice, diluted.
Cooked cereal or bland dry cereal.
Two soft cooked eggs.
Toast and butter.
Bland fruit.[2]
Milk, one glass.

1130

Creamed soup.
Tender meat.
Bland potato.[1]
Bland puree vegetable.
Salt (sparingly).
Toast and butter.
Milk, one glass.
Bland fruit.[2]

1630

Creamed soup.
Bland potato.[1]
Puree vegetable.
Custard.
Toast and butter.
Milk, one glass.

Diabetic

1. A diabetic diet is planned by the medical officer to meet the nutritional needs of the patient (sufficient caloric intake to maintain body weight slightly below average and adequate in essential nutrients).

2. The diet is calculated to provide normal amount of protein, somewhat restricted amount of carbohydrate and sufficient fat to make up the caloric requirements of the patient.

3. Cooked foods are prepared by broiling, boiling or roasting. Fried foods are to be avoided unless the fats used are calculated in the diet. Only the foods listed on his menu, in the specified amounts, are served to the patient. Saccharine may be used as a sweetening agent in the place of sugar.

4. Foods allowed include: Cereals; plain unsweetened breads; fresh and water packed fruits;

fresh frozen and canned vegetables; broths and clear soups; lean meats, poultry and fish; milk; eggs; cheeses; butter, oils and cream; custards and gelatin dishes made without sugar; unsweetened tea, coffee, fruit juices; condiments. Potatoes and potato substitutes, such as macaroni, rice, spaghetti, noodles, corn, dried peas or beans are used in limited quantities.

5. Foods to be avoided are: Sugar in all forms including candy, gum, honey, syrups, molasses, jellies, jams, and preserves; canned fruits unless water packed; pastries, cakes, crackers, pretzels, and cookies; all sweetened desserts; popcorn; all soft drinks and alcoholic beverages.

Cardiac

1. In general, the diet should be low in salt or sodium content, should be readily digestible and served in frequent small feedings. The fluid intake may be restricted. Any foods causing gas and distention should be avoided (members of the cabbage family, dried peas and beans).

2. In the presence of acute cardiac failure, the diet may be limited to water and fruit juices for 1 to 3 days, then increased to 800 cc. milk distributed over the 24-hour period. As the patient improves, the diet is gradually increased to a full soft low sodium diet.

3. Foods allowed include: unsalted meat, fish, poultry (one 2 to 3 ounce serving); milk (limited to 500 cc. used as milk or creamed soups); one egg daily (used as egg or in cooking); unsalted cooked cereals, puffed rice or wheat, shredded wheat; unsalted bread and sweet* butter; fruits; unsalted fresh or frozen vegetables, except those to be avoided; one dessert daily other than fruit; unsalted cottage cheese; sugar; vegetable oils; jelly, marmalade; seasonings such as lemon juice, paprika, garlic, extracts of vanilla, rum, lemon and peppermint.

4. Foods to be avoided are: Salt and foods prepared or preserved with salt; self-rising flours and mixes; cured meat, such as ham, bacon, and sausage; fish, if processed with brine; all cereals except those allowed; salted butter, mayonnaise, French dressing; all commercially canned vegetables and beets, kale, Swiss chard, spinach, celery, frozen peas, lima beans; all cheese except cottage cheese; salted nuts, crackers and broths; pickles, olives and condiments such as catsup, chili sauce, prepared mustard, steak sauce, celery and onion salt.

*Salted butter may be made "salt free" by kneading and washing it under cold running water.

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Chapter VI

PREVENTIVE MEDICINE

The old adage, "an ounce of prevention is worth a pound of cure," was never so true as in the Navy, where it is more important to keep a man on duty than to treat one who is sick and finally get him back to service.

For this reason our aim is first to prevent disease and then to keep every man in tip-top health—a state of complete physical, mental, and social well-being.

No matter what duties the hospital corpsman is assigned, he should always keep his eyes open to prevent the spread of disease and to improve the health of his shipmates.

Communicable Diseases

If a communicable disease breaks out aboard ship, it will be the duty of the hospital corpsman to care for the sick patient and prevent the spread of the disease to others. He must be aware of the dangers of such an outbreak. If many cases occur, the sick bay, the medical supplies, and the time of the hospital corpsmen will be taxed beyond limit. This may also endanger the safe and efficient operation of the vessel.

At all times, the hospital corpsman must be aware of the personal dangers to himself, for he will of necessity be in close contact with the patients in the sick bay and hospital ward, and be exposed to infectious diseases. So he must be aware of how these diseases are spread, and how he can protect himself against them.

Portals of Entry

Infections organisms enter the body through the skin, the respiratory tract (nose, throat, and lungs), the digestive tract (stomach and intestines), or the genitourinary tract (penis, bladder, kidneys).

Most diseases have a specific portal of entry; for example, cholera and dysentery enter through the digestive tract; malaria, through a skin puncture made by the anopheles mosquito; and pneumonia, through the respiratory tract. Tetanus enters through deep wounds.

If the organism happens to enter the body some place other than its usual portal of entry, the disease may not develop. For example, tetanus bacilli may be harmless if swallowed along with food or if placed on the unbroken skin; it may cause a deadly infection if the bacilli enter through a deep wound.

If one knows the usual portal of entry, control measures can be taken. For instance, food or water would be suspected as agents for the spread of dysentery or cholera since the digestive tract is the portal of entry for these diseases (fig. 351).

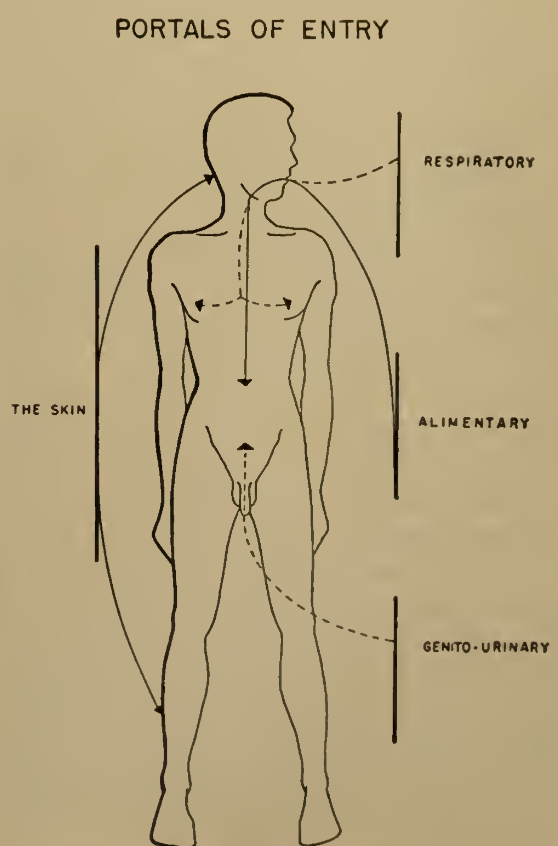

Figure 351.—Portals of Entry.

Transmission Methods

Disease is transmitted by the following methods:

By contact.—Direct contact of body surfaces of two or more individuals, such as that occurring during kissing or sexual intercourse. Venereal and skin diseases fall in this class. Diseases spread by body contact can be avoided largely through personal care. Cleanliness of the hands and clothing is obviously important. This is one of the reasons why good personal hygiene should be enforced throughout the entire ship or station.

By direct contamination from fingers and hands which have been in contact with infected secretions, or indirect contamination of hands and fingers by way of doorknobs, etc. In some cases, sea spray over the face and hands during small-boat operations in polluted harbors may be the means of contamination.

By spray or droplet infection from the mouth or nose while talking, coughing, or sneezing. Droplets which contain the germs inhabiting the mouth and respiratory passages remain in the air for varying lengths of time and may be scattered 6 or 8 feet without air currents, and even farther if there is air movement.

Droplet diseases can be controlled by avoiding sneezing or coughing close to another person. Covering the mouth with the hand or clean handkerchief is good standard procedure.

A good rule is: Steer the cough onto your own chest and not into the chest of another. This should be called to the attention of personnel who have colds or other respiratory illnesses.

By intermediary objects.—Foods—water and ice, milk and other dairy products, meat and shell fish, and vegetables—are often the vehicles of intestinal infections such as typhoid, dysentery, or cholera. Parasites are commonly transmitted through meat. The excreta of a sick person usually contain great numbers of the causative organisms of his disease. Through carelessness these germs may get into the water, milk, or food and thus infect a number of new victims.

Hospital corpsmen should ever be alert to the possibilities of spreading an infection from the sick bay to the rest of the crew.

By fomites.—Towels, clothing, dishes—used by an infected person and contaminated with infected discharges. These, if not properly disinfected or sterilized, can pass on the disease to the next user.

By insects as mechanical carriers of germs.—The common fly may carry bacteria from the discharges of an ill person in the sick bay into the galley and onto the food.

At sea the fly is not generally a nuisance, but in port and in shore stations flies will be prevalent, especially in warm areas and where sanitary conditions are not satisfactory. If flies are kept away from infectious material, fly-borne disease will not be possible. Proper waste disposal, especially in the galleys and heads, is of importance in preventing the presence of large numbers of flies.

By insects acting as hosts of bacteria.—For example bubonic plague is generally transmitted from infected rats to man by the bites of fleas; also by fleas from other rodents.

Since fleas are common on rats, and rats are frequently found aboard ships and stations, plague is a potential danger. This is of particular importance when a ship is tied up at or just departing from a plague port.

By insects harboring microorganisms in their bodies which are excreted in the saliva. Malaria is transmitted in this way by the anopheles mosquito.

Other lower animals.—For example, rabies from the bite of a rabid dog.

By man acting as a carrier.—Even if a man is not ill he can carry or transmit diseases. Apparently healthy persons can carry polio and meningitis germs in their nose and throat. Chronic carriers may harbor typhoid in the gall-bladder, for example. Typhoid carriers should never be employed as food handlers.

The first step in controlling infectious diseases is to know their portals of entry and how to prevent the disease germs from entering the human body.

THE BODY'S DEFENSES AGAINST DISEASE

The body's defenses against disease are:

1. The skin.

2. The mucous membranes of the respiratory, digestive, and urinary tracts.

3. Body secretions—mucus in the respiratory tract catches and traps bacteria and dust; digestive juices of the stomach and intestines tend to kill bacteria; perspiration tends to wash away bacteria.

Body immunity.—Despite the surface defenses of the body to prevent these germs from entering, some microorganisms do find their way into the body. An internal resistance against infection is found in the blood, lymph, and other secretions and body tissues. The two systems which protect the body are the antibodies and the white blood cells.

Antibodies tend to neutralize the effect of disease germs or viruses in the body. Repeated small injections of a disease germ stimulates the formation of antibodies. For example, when we inject vaccines it is the production of these antibodies which later prevents the disease from developing. In general, an antibody is specific against one microorganism.

White blood cells, together with antibodies, are the blood warriors against micro-organisms. And together with antibodies, they tend to engulf and swallow up the disease germs, or destroy them.

Immunity depends upon the body's resistance and the virulence of the invading organism. There are two types of immunity, *inherent* (from birth or inherited from the mother) and *acquired* (from disease contact, inoculation, or vaccination).

Naturally acquired immunity is from disease contact.

Artificially acquired immunity is from inoculation or vaccination.

Active immunity is when antibodies are produced in or by the body of the person himself.

In passive immunity the antibodies are first produced in another animal or person, such as a cow or horse, and then injected into the patient to be immunized.

Not all diseases confer partial or complete immunity by an attack. Nor is it possible to produce artificial immunity to all diseases.

Methods of Prophylactic (Preventive) Immunization

Vaccination.—Smallpox vaccination is made with cowpox lymph which gives a cross immunity in humans to smallpox. By producing a mild attack of cowpox, a person may get immunity which may last from less than 2 years to more than 20 years. Since smallpox is an ever present threat vaccination is vitally important in the navy.

Inoculation.—Killed typhoid-paratyphoid A and B bacilli, when injected in large numbers, produce an immunity to these diseases. Its duration is variable, but becomes important when entering foreign ports having poor sanitation. Tetanus toxoid and diphtheria toxoid contain a modified toxin of these organisms. The toxoid injection stimulates immunity, and this can be renewed or pushed to a higher level by later "booster" injections.

Skin test for disease susceptibility is shown in the Schick test for diphtheria. A small drop of diluted toxin is injected in the outer layers of the skin. Only susceptible persons will get a reaction.

Vaccination technique.—A cowpex virus must never be injected deeper than the skin itself. In performing a vaccination prepare the skin by wiping it with acetone or ether and let it dry, before applying cowpox lymph. If antiseptic is present it will kill the virus, rendering the vaccination worthless, or cause a false reaction. So let the skin dry, apply a drop of the cowpox lymph, then hold the needle "on the flat" or tangent to the curve of the arm just below the shoulder. By pressing a number of times in a small area through the drop of cowpox lymph, you will note that the skin tends to fold or roll over the needle point. Just let the needle barely break the skin without releasing blood from deeper tissues.

Triple typhoid inoculation.—This injection should be made in the loose subcutaneous tissue. If injected beneath the sheath of the underlying muscle, severe reactions may follow. The typhoid "booster" consists of 0.1 cc. given intradermally, 0.5 cc. given subcutaneously if intradermal reactions are intense.

Schick test.—One-tenth cc. of diluted toxin injected intradermally to the inside of the forearm. Be sure to remember the control which is equally important, in interpreting the reaction to the toxin.

Diphtheria toxoid should be given subcutaneously because of its fluid nature.

Tetanus toxoid.—Alum-precipitated is deposited intramuscularly.

Yellow fever vaccine instructions must be carefully followed.—Especially follow precautions in diluting the yellow fever vaccine so that uncontaminated exact amounts are injected. Note the lot number.

Tuberculin test—An intradermal injection of 0.0001 milligram of Purified Protein derivative of tuberculin on the volar aspect of the forearm. No control injection is required.

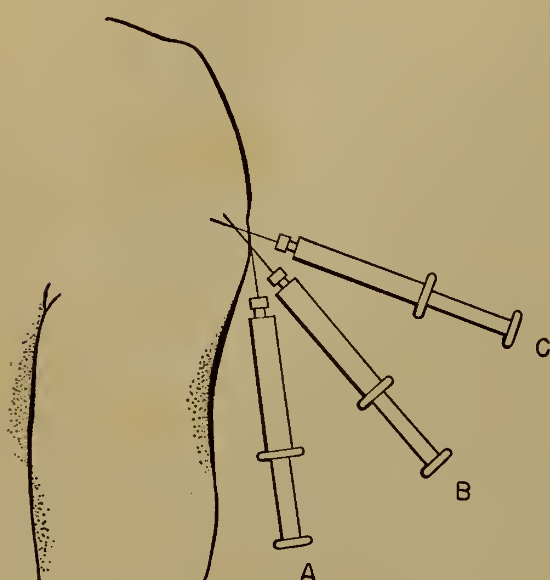

Figure 352.—Injections of Immunizing Agents: (a) Intradermally; (b) Subcutaneously; (c) Intramuscularly.

Shake before using all bacterial vaccines to insure good bacterial suspension. The corpsman giving inoculations must be sure of the correct dosage at all times.

Change needles or syringe if blood is aspirated during an injection. In intramuscular inoculations, aspirate (draw back on the syringe plunger) before injection to be sure the needle has not entered a blood vessel. If repeated injections are made using one syringe and changing needles, extreme caution must be exercised. For if blood or plasma is aspirated the syringe as well as the needle must be discarded following the inoculation. A newly sterilized and filled syringe must then be used. In all injections made intravenously no repeated inoculations shall be made because blood is withdrawn in each case.

Storage of vaccines.—Vaccines, especially viruses such as cowpox lose their potency when not refrigerated. Cowpox vaccine must not remain longer than one hour at temperatures above thawing. It should be kept in the freezing compartment of the refrigerator.

Yellow fever vaccine should be kept frozen and not thawed more than 60 minutes before diluting and using. Once diluted, vaccine should be packed in ice. All unused portions of the diluted vaccine must be discarded after 60 minutes.

Cholera and typhoid vaccines and tetanus toxoid (alum-precipitated) should be kept under refrigeration and shaken well before using.

Typhus vaccine should also be kept refrigerated. Strict attention should be paid to the instructions pertaining to storage, dilution, and use which are printed on vaccine labels.

For more detailed immunization facts, read section, "Immunization," Manual of the Medical Department, United States Navy, and current Bureau of Medicine and Surgery Instructions.

Reactions

Serum sickness.—The injection of antibodies sometimes causes undesirable reactions ranging from slightly annoying symptoms to fatal results. Serum sickness may appear within 1 or 2 days following an injection of a vaccine or inoculation but more often after 6 to 10 days. The patient may complain of headache, fever, joint and muscle pains, edema, and various skin eruptions such as hives.

Mild attacks clear up with rest, mild skin lotions, and catharsis. Epinephrine will often relieve the hives.

Anaphylactic shock.—This occurs a few minutes after the injection and may be fatal. It is characterized by restlessness, anxiety, difficult or

labored breathing, bluish discoloration of the skin, and edema. Anaphylaxis means that the patient is hypersusceptible to the serum or vaccine (often due to types grown in eggs).

It does not mean the antitoxin or vaccine is poisonous. How one becomes sensitive is not clear. A previous injection of horse serum or a hereditary tendency may account for it.

Precautions.—Because of these reactions to serums and egg vaccines you should ask the patient if he has had a previous injection of serum, or if he is sensitive to meat, fowl, or eggs or ever had asthma, hives, or hay fever.

To prevent anaphylactic shock when giving serum, inject one-fiftieth cc. of serum intracutaneously (in the skin) as a test for hypersensitivity. If the test is positive, the patient should be desensitized. Unless, of course, the patient has asthma aggravated by coming in contact with horses and is so sensitive that he cannot be desensitized.

Patients having asthma and a strongly positive skin test should be given the first desensitizing dose subcutaneously. Begin with 0.005 cc. to 0.025 cc., and double the dose every half hour until a dose of 1.28 cc. is given on the ninth dose. Then 0.1 cc. is injected intravenously and the dose should be doubled every twenty to thirty minutes until the required amount is given; dilution with physiological saline one to ten is advisable when unrefined serum is used.

If only a mild skin reaction appears desensitization can be shortened by starting with a larger dose and increasing the size in subsequent doses. Always keep at hand a syringe containing epinephrine 1:1000 when administering serums or vaccines.

Treatment of Anaphylactic Shock

Anaphylactic shock must be treated promptly. Stop the serum immediately. Place a tourniquet above the site of injection if possible. Give epinephrine 1:1000, 5/10 cc. to 1 cc. subcutaneouly. Repeat at short intervals if necessary, until relief is obtained. Make certain that the tongue of an unconscious patient has not blocked his airway; otherwise all treatment may fail to revive him.

Whenever possible, inject serum in the outer area of the thigh intramuscularly, since here a tourniquet may be easily applied to stop the absorption in case symptoms of serum sickness appear.

SPECIAL DISEASE PROBLEMS

For more details on communicable diseases of men than those given below, see *The Control of Communicable Diseases in Man*, American Public Health Association, 1950, seventh edition. This is official with the United States Navy and is available in all ship and station medical libraries.

Venereal Disease Control

Venereal diseases require special attention because: (1) they tend to keep hidden from medical observation; (2) they tend toward chronic, long-term physical condition; (3) they frequently cause marital, family, social, and economic problems not easily solved; and (4) prevention depends largely upon the individual.

The Venereal Diseases

Syphilis.—This is caused by the *Spirochaeta* or *Treponema pallidum.* The incubation period is variable (10 to 90 days, rarely longer). The first sore of primary or early syphilis appears at the site of entrance of the spirochete into the body. This sore, called a chancre, may last from 1 to 6 weeks and heal with or without treatment. Diagnosis at this stage is by finding the spirochete in the dark field microscopic examinations of serum obtained from the chancre. Serological tests for syphilis will probably be negative, if the chancre has only recently developed.

Secondary syphilis may appear in the form of macular (spotty) skin rash (often faint copper colored), usually accompanied by large lymph nodes. This rash appears 3 to 8 weeks or longer after the appearance of the chancre. There may also be papules (raised bumps), sore throat, with patches in the mouth, and partial loss of hair. These secondary signs usually disappear within about 3 weeks. If untreated they may reappear one or more times as relapses. Diagnosis may be made from some lesions by dark field examinations. Moist secondary sores should always be examined by dark field. The serological test for syphilis is almost always positive during this secondary stage.

Latent syphilis is that stage of the disease in which clinical signs and symptoms of infection are absent, the diagnosis being made by the presence of persistently positive serological tests and con-

firmed by the Treponema pallidum immobilization test. The patient's spinal fluid is normal. Since there are many diseases and conditions other than syphilis which render standard serological tests positive, the diagnosis of latent syphilis should not be established until serological tests have been repeated and confirmed by a positive Treponema pallidum fixation test. Latent syphilis is arbitrarily subdivided into "early" or "late" latent syphilis at a point 4 years after onset of infection.

Late syphilis (formerly called tertiary syphilis) follows secondary syphilis after a period of quiescence for from 1 to 20 years. Among the infinite variety of manifestations of this stage may be blindness (primary optic atrophy), insanity (paresis or general paralysis), vascular disease (disease of the heart or blood vessels), loss of position sense, Charcot joints (atrophy arthritis), or destructive ulcers of the skin or mucous membranes.

Gonorrhea

This is caused by a germ, *Neisseria gonorrhoeae* or the gonococcus, a gram-negative diplococcus. The incubation period is from 1 to 14 days, usually 3 to 5 days. This organism has an affinity for, and grows in, the urethra.

Signs of the disease are a purulent (creamy) yellow discharge from the urethra in the male (may only be watery or mucoid) and a purulent yellow discharge from the cervix or urethra in the female. Without proper treatment, the discharge may be prolonged. But with penicillin treatment it disappears in 1 to 2 days and with sulfa drugs somewhat less quickly.

Diagnosis is by microscopic examination of smears and by cultures. Smears are made from the discharge and stained with Gram stain technique. Bacteriological cultures are necessary to confirm diganosis in certain instances and should be used as one of the criteria for cure, particularly in the care of females. Two negative cultures at 24-hour intervals are recommended. The possibility of reinfection must be considered whenever a positive culture follows a negative one. Follow up should include monthly blood tests for syphilis for 4 months; the test at 4 months is the most essential one.

Complications of gonorrhea in untreated cases are inflammation of the epididymis and prostate, and stricture of the urthera. Pelvic inflammatory disease and inflammation of the ovaries occur in the female. Arthritis and sterility may occur. In rare instances, heart disease or septicemia occur. The disease is infectious as long as gonococci are harbored in the prostate, cervical, or other genital tissues.

Chancroid.—Chancroid is caused by the Ducrey bacillus (Hemophilus ducreyi) and is diagnosed by microscopic examinations of stained smears and cultures from the sore or sores, by a skin test (Ito-Reenstierna test). It is characterized by local, rapidly developing, painful, usually multiple sores. The incubation period is short (3 to 5 days) but may vary between 2 to 12 days. The lesions are very painful and are often accompanied by a painful and tender swelling of the regional lymph nodes (bubos), usually unilateral.

Lymphogranuloma venereum.—Lymphogranuloma venereum is caused by a virus and usually starts with a small transitory sore located on the penis or around the genitals. It is a disease of the lymph nodes and channels and usually in bubo formation. In neglected cases it may cause rectal stricture (in female) and genital elephantiasis in both sexes. Diagnosis may be confirmed by the Frei test (a skin test). The incubation period varies from 1 to 4 weeks.

Granuloma inguinale.—Granuloma inguinale is caused by Klebsiella granulomatis (Donovan body). This disease begins with a small pimple or painless sore after an incubation period of from a few days to several months. It starts as a papule or nodule which ulcerates and spreads by continuity (satellite ulcer developing near larger ulcers) and may involve the scrotum and thigh. This disease is not accompanied by bubo formation. The disease may last for years, during which it may cause serious destruction of genital organs and spread to other parts of the body.

Conditions simulating venereal diseases.—Sometimes sores or inflammations on the genitals are caused by ordinary organisms associated with unclean habits. Crab lice, scabies (the itch), other insect bites, Vincent's fuso-spirillosis, venereal warts, hair follicle infections, streptococcic and staphyloccic infections secondary to injuries, herpes progenitals (fever blisters), sim-

ple dermatitis, urethral discharges or sores repeatedly negative on laboratory examinations are to be differentiated from the venereal diseases.

Under no circumstances should strong caustics, blue ointment, penicillin, or other antibiotic ointments be applied locally to undiagnosed genital infections. Penicillin, aureomycin, or the other newer antibiotics should never be administered systemically until a definite diagnosis has been established. (Fig. 353.)

Venereal disease control program

Venereal disease control in the Navy and Marine Corps is part of a worldwide effort to reduce the reservoir of venereal disease by preventing venereal infection, by adequately treating all infected individuals, and by preventing spread of the disease germs. Figure 354 shows the coordinated venereal disease control program in the United States Navy and Marine Corps.

The medical program is only one part of the total venereal disease control program and consists of:

Education

1. **For all naval and Marine Corps personnel.**—Present medical facts in simple terms concerning sex hygiene and venereal disease, the cause, how spread, early symptoms, necessity for prompt reporting if infection develops or is suspected, need for follow-up, and necessity for remembering names, addresses, and description of sexual contacts. Emphasize that all punishment for getting a venereal disease has been eliminated.

2. **Medical department personnel.**—Furnishing of technical information to all medical depart-

Venereal Disease Summary Chart

	Syphilis	Gonorrhea	Chancroid	Granuloma inguinale	Lymphogranuloma venereum
Common names or synonyms.	"Syph," "pox," "lues," "old Joe," "bad blood," "hard chancre," "chancre."	"Clap," "dose," "strain," "the drip," "running," "gleet," "GC."	"Soft chancre," "bubo," "hair cut."	"Ulcerative granuloma of pudenda."	"Lymphopathia venereum"; "lymphogranuloma inguinale."
Germ causing disease (etiology).	*Treponema pallidum* (popular term, "spirochete").	*Neisseria gonorrhea* (gonococcus).	Ducrey bacillus	Donovan bodies	A specific filterable virus.
Method of spread	(1) Usually sexual intercourse. (2) Kissing and fondling. (3) Prenatal (mother to fetus).	Sexual intercourse and ophthalmia infection at birth.	Sexual intercourse	Sexual intercourse; direct contact by skin and mucous membrane.	Sexual intercourse; direct contact by skin and mucous membrane.
Incubation period	10 to 90 days.	1 to 14 days.	1 to 12 days.	2 days to several months.	1 to 4 weeks.
Clinical signs and symptoms.	*Early:* Primary—chancre. Secondary—rash, mucous patches, sore throat, headaches, fever, etc. *Latent* (early latent; late latent) (seropositive only). No active manifestations. *Late (tertiary):* Active manifestations: Cardiovascular, neurosyphilis, gumma, ocular, osseous, visceral. *Mucocutaneous relapse:* Recurrence of infectious lesions after disappearance of secondary lesions.	*Male:* Purulent urethral discharge; burning on urination; pain (sometimes); inflammation and swelling. *Female:* Possibly no symptoms; vaginal discharges; pain in abdomen (when salpingitis occurs).	Frequent multiple or single, painful, tender, rapidly growing, nonindurated ulceration, with undermined border ragged edge, and gray wet base.	Red, granular, shiny, well defined, granulating ulcer, slowly growing but progressive.	Frequent absent history or presence of a pimple or small ulceration in about one-third of the cases; bubos; rectal stricture in late stage in female.
Diagnosis	Darkfield examination. Serological tests. Treponema Pallidum immobilization test. Case history. Clinical signs and symptoms. X-ray.	Smears. Cultures. Case history. Clinical signs and symptoms.	Darkfield (to exclude syphilis). Skin tests (Ito-Reenstierna). Presence of Ducrey bacillus. Case history. Clinical signs and symptoms.	Darkfield (to exclude syphilis). Case history. Clinical signs and symptoms. Presence of Donovan bodies.	Darkfield (to exclude syphilis). Case history. Clinical signs and symptoms. Frei skin test.
Treatment	Penicillin. Arsenicals. Heavy metals (bismuth). Combination of arsenicals and heavy metals, or all three.	Penicillin. Sulfonamides. Combination of penicillin and sulfonamides.	Sulfonamides. Cleanliness. Hot soaks.	Streptomycin, aureomycin. Tartar emetic, fuadin, etc., intravenously. Cleanliness. Surgery. X-ray.	Sulfonamides. Dilatation of rectal stricture.

Figure 353.—Venereal Disease Summary Chart.

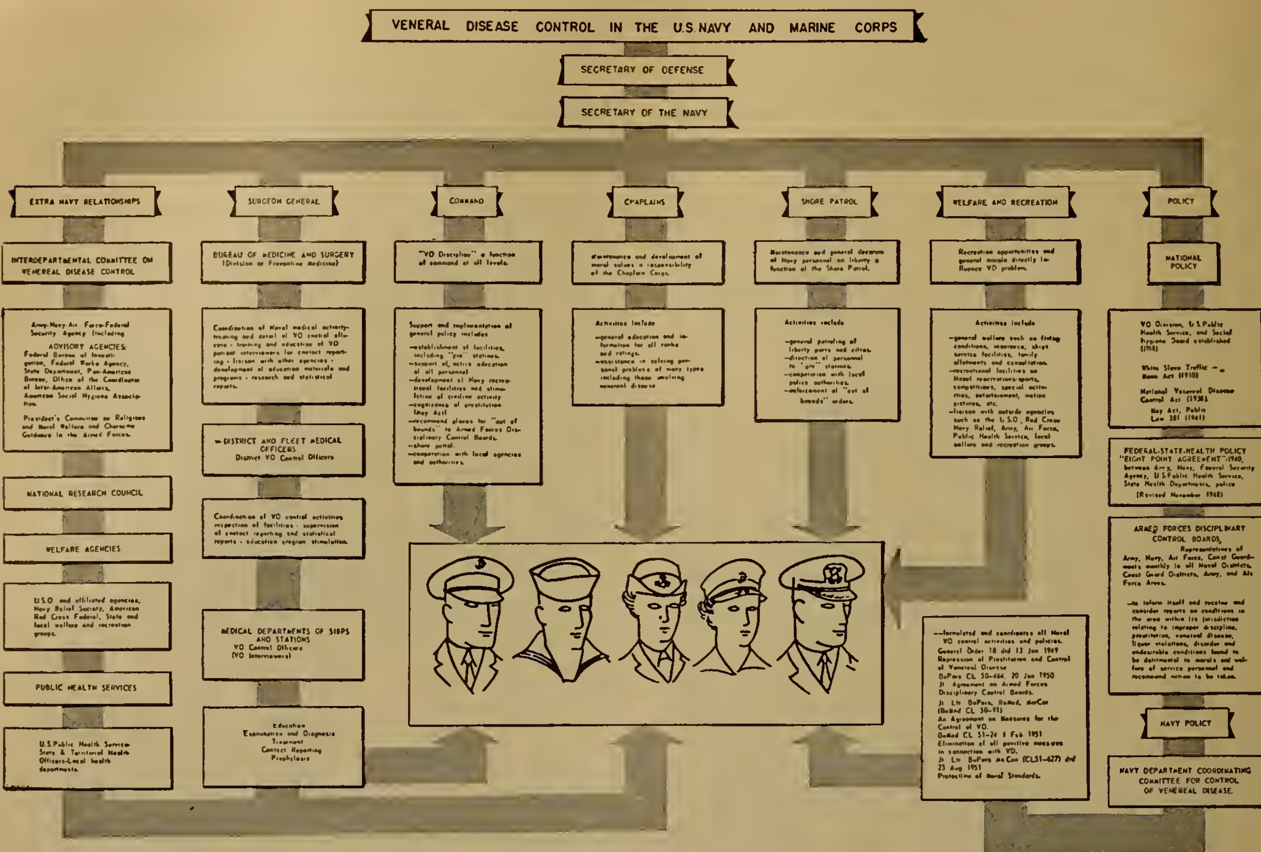

Figure 354.—Venereal Disease Control in the U. S. Navy and Marine Corps.

ment personnel in order to properly carry out their personal responsibilities.

Diagnosis, Treatment, and Follow-up

Apply modern methods of diagnosis and treatment.

Obtain adequate follow-up for evidence of cure, relapse, concomitant infection, or making of other venereal diseases.

For additional information on this subject obtain a copy of the Guide for the Diagnosis, Treatment, Follow-up of Venereal Diseases in the United States Navy, NavMed P–1319. This publication affords a convenient summary of the latest information on the administrative and clinical management of all the venereal diseases.

Prophylaxis

1. Early use of condom before any sex play and during every promiscuous sexual exposure.

2. After exposure, immediate urination followed by soap and water wash of genitals and surounding area.

3. Oral penicillin tablets are available as an additional prophylaxis measure for prevention of gonorrhea in noncontinental areas of high venereal disease incidence. Oral penicillin tablets will not prevent the other venereal diseases.

Contact Investigation

Obtain identification and reporting of all sexual contacts of infected individuals for that period of time in which the individual could have acquired or spread his infection.

Arrange for investigation of all military contacts named by infected civilians.

For additional information on this subject obtain a copy of the Interviewer's Aid for VD Contact Investigation, NavMed P–1288. This publication contains basic information about the venereal diseases, their cause, effect, epidemiology, methods for eliciting information by the interviewer, a copy of the contact report form and in-

structions for routing, and eleven visual aids, which have proved to be of inestimable value in patient reeducation.

Liaison and Environmental Control

Military forces cooperate with other governmental agencies, Public Health Service, law-enforcement officers, social welfare, and civic authorities in an effort to decrease the reservoir of venereal disease infections, to improve environmental conditions in cities which military personnel frequent, to suppress prostitution, and to provide wholesome recreational facilities. This requires coordination of effort between the command, chaplain, medical, welfare, and shore patrol personnel.

The Venereal Disease Educational Program

An educational program for all naval and Marine Corps personnel should be conducted by the command, chaplain and medical departments. Each has a specific responsibility in the educational program. The chaplain in particular should handle the moral and sex educational aspects of the control program. The Armed Forces Chaplain's Visual Presentation on Sex Education (A), given by the chaplain, should precede the following medical facts presentation:

1. Acquaint the individual with sex hygiene and the disease which can result from promiscuous sexual intercourse.

2. Impress the facts that:

All of the venereal diseases are caused by germs. A different germ causes each of these diseases, just as different germs are responsible for causing tuberculosis and the common cold.

Venereal disease germs are usually passed from one person who has the VD germs in a sore on the sex parts or a discharge from the penis to another person during sexual intercourse. (For a time after the germ enters the other person's body, certain symptoms, such as a sore on the sex parts or a discharge from the penis, may occur. This sore or discharge is usually the first visible evidence that the person has a venereal disease. Numerous germs are present in the sore or discharge and if this person has sexual intercourse with other persons during this period the germs may spread to them, and when they in turn develop sores or discharges germs may be passed to others. Thus each new case may start a web or series of new infections.

Venereal disease germs are mainly spread by: Promiscuity (sexual intercourse with several persons, some of whom may be infected); pick-ups ("loose" or "easy" women—the kind one may pick up in bars, dance halls, or on the street); prostitutes (women who "work" in a "house" or "work" on the streets).

Venereal diseases actually exist from the moment that the germs get on the sex parts and begin to multiply. The visible symptoms of these diseases appear at varying time periods following sexual intercourse with an infected person.

3. Establish firmly the early signs and symptoms of venereal diseases which are usually or commonly noticed by the individual. Discuss secondary symptoms and time period of occurrence of symptoms. Emphasize the fact that all punishment for getting a venereal disease has been eliminated. Discuss dangers of self-treatment, treatment by unauthorized sources, or of failure to seek treatment.

4. Establish the facts on prevention and prophylaxis. By far the best way to avoid acquiring a venereal disease is to avoid illicit sexual intercourse. If exposure is planned, then most infections can be prevented by certain measures before and after exposure. The medical name of these measures is prophylaxis.

Prophylaxis Consists of

Early use of condom before any sex play and during every promiscuous sexual exposure. The condom acts as a barrier which keeps the germs from being passed from one person to another.

Use of individual prophylaxis and prompt reporting to prophylaxis stations (limitations of prophylaxis should be discussed).

Personal hygiene and cleanliness.

5. Establish the responsibilty of the individual to:

Avoid promiscuity.

Use prophylaxis if exposed.

Promptly report to a medical department when signs and symptoms of infection occur or are suspected. All penile sores or discharges from the penis should be brought to the attention of the medical officer.

Name all sexual contacts during that period of time in which the person could have acquired or passed on the germs which caused his infection.

Need for adequate follow-up in case of infection.

Suggestions for Venereal Disease Talks to Crew

Use visual aids freely (films; Ozalid transparencies, NavPers 110052; magic boards; blackboards; posters, etc.).

Have small group discussions.

Have seminar-type discussions. (Each person participates in the learning process.)

Use simple language (nontechnical) ; i. e., germs cause gonorrhea, rather than to say "Neisseria gonococci" cause gonorrhea. Do not attempt to get over technical facts so that the man will diagnose his condition.

Use short sentences; explain new words.

Attempt to leave one or two thoughts with the audience.

Encourage questions from the audience.

Use questionnaires; correct any errors or fallacies; discuss questions and answers freely.

Make each person feel that you are personally talking to him.

NOTE.—Before attempting to give a VD lecture, talk, or presentation, medical personnel must thoroughly familiarize themselves with suggested references and coordinate the program with that of the chaplain. Both the Medical Department representative and the chaplain should know what the other is presenting.

Tuberculosis Control

The control of tuberculosis in the Navy is accomplished in part through chest X-rays of all individuals on their first acceptance for naval service. This procedure is supplemented by the tuberculin skin test done on all Navy and Marine Corps recruits.

This skin test does not indicate the presence of active tuberculosis but does reveal, in the case of a positive reaction, that at some time in the past the individual has had a tuberculosis infection. The diagnosis of active tuberculosis can only be established by extensive clinical and laboratory examinations, usually in a hospital.

The control of tuberculosis is further advanced through annual chest X-ray examinations of all military and civilian personnel of the naval establishment. At time of separation from the Navy, personnel receive a physical examination including an X-ray of the chest.

PERSONAL HYGIENE

Hygiene is the science of keeping healthy through good health habits and avoiding disease contacts. Here are a few general tips on keeping yourself healthy and clean.

At the first sign of illness report to the sick bay. Many illnesses can be shortened or arrested if treated early. Self-treatment should never be attempted since you may harm yourself with the wrong treatment and postpone good treatment. To say nothing of being a danger to your shipmates, remember, "A person who treats himself has a fool for a patient."

Avoid close contact with strangers and persons who appear ill except as your duty requires it. Your medical officer will instruct you in the precautions to be taken for your protection.

Cover the nose and mouth when sneezing or coughing and encourage others in this habit.

Avoid crowds when many people are having colds and sore throats, and when you have one.

Avoid using toilet articles or personal items of others and do not allow your shipmates to use yours.

Avoid excesses.—Under the influence of excessive amounts of alcohol the brain centers that control reasoning, judgment, and self-control are no longer under restraint. The result is poor judgment, lowering of moral restraints, weakening of self-respect, and false confidence in your physical and mental ability. When intoxicated you may fall easy prey to those wishing to take advantage of you and you cannot conduct yourself in a manner to command respect or follow the simple rules of hygiene necessary for your well-being.

The hospital corpsman is expected to set a good example in personal hygiene for all hands. He should "spread the gospel" of good hygiene by instructing other personnel.

Specific Hygiene Hints

Keep your body clean.—Bathe daily, if possible, but always wash your feet, armpits, and

genitals. Where bathing is not possible scrub the body with a wet, soapy cloth, paying particular attention to washing and thoroughly drying the armpits, crotch, and feet. Fungus infection at these sites can often be controlled by dusting with standard foot powder after drying.

Keep your hands clean.—Always wash hands with soap and water before eating, after using the toilet, and after touching anything believed to be contaminated. Keep your fingers away from the nose and mouth. Keep your fingernails clean and short. When you think of the many things your hands do each day you can see the need for frequent washing. The new soaps containing hexachlorophene (G–11) are valuable in keeping your hands safe and clean (fig. 355).

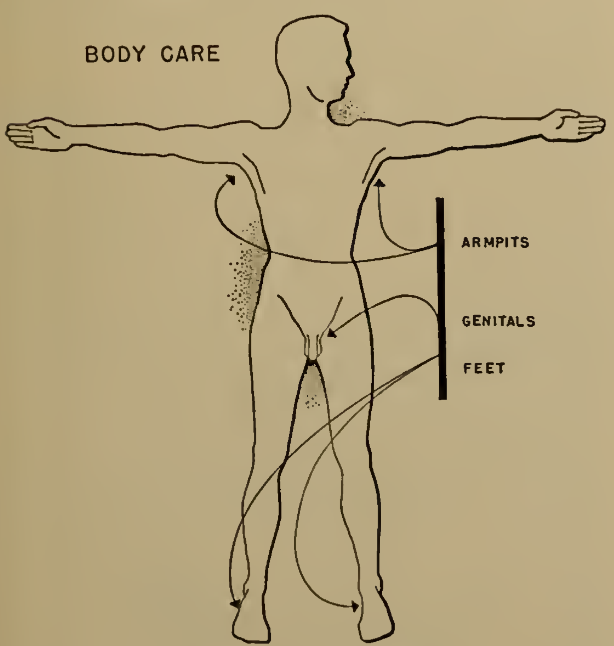

Figure 355.—Body Care.

Take care of your feet.—The proper care of your feet, shoes, and socks will prevent uncomfortable and even crippling conditions such as infected blisters and severe fungus infections.

Wash your feet daily. Dust with foot powder, particularly between the toes. If you have been on a march, follow this routine:

1. Remove shoes. Clean, dry, and dub them (rub or dress with grease).
2. Wash your feet in cold water to tone up the foot muscles. Inspect your feet for blisters and other infections.
3. If your feet are tender, bathe them in cold boric acid solution, alcohol, 1 percent formaldehyde solution, or 2 percent alcoholic solution of salicylic acid.
4. Put on clean socks and shoes.
5. Wash and dry soiled socks for next day.

Toenails should be trimmed straight across to prevent ingrowing toenails and should be kept clean. Never tear a toenail. Another way to prevent ingrown toenails is to scrape the upper surface of the nail in the center. This causes the nail to be thinner in the middle and allows the growing nail to turn outward at the edges.

Your socks should be kept clean and changed daily. Change shoes as frequently as possible.

Make sure your shoes and socks fit well. Recruits should not call out for the same size shoe worn in civilian life, but standing with full equipment should have the foot measured. The inner surface of the shoe should be a quarter of an inch longer and wider than the foot. New shoes should not be worn on marches.

It is equally important to wear properly fitting socks, and the proper sizes to be worn with the required length of shoe are given below:

Shoe size:	*Corresponding sock size*
5–5½	10
6–6½–7	10½
7½–8–8½	11
9–9½–10	11½
10½–11–11½	12
12–12½–13	12½
13½–14–14½	13
15	13½

Socks of light wool in summer and heavy wool in winter are preferable to cotton fabric. Ribbed socks are better than plain ones as they are more elastic and fit the foot better. The life of a good light wool sock is about 100 road miles, but if the feet are wet the socks will wear through much sooner. If your socks are too large they will form folds and thus cause pressure injury of the foot. If too small they will tend to produce ingrown toenails, bunions, and club toes.

Socks colored with aniline or irritating dyes which wash out with perspiration should not be

worn. Gray or white ones are preferable. Turning socks wrong side out, and changing socks from one foot to the other equalizes wear and is conducive to comfort. Holes in socks are apt to cause blisters. Avoid using darned socks.

In shower rooms wear wooden clogs to avoid fungus foot infections.

Treatment of foot disorders.—Puncture blisters at the base, using a sterile needle; remove the serum and paint with an antiseptic solution. Cover the blister with adhesive tape with a small hole in the center to allow discharge to escape.

Smelly feet (bromidrosis) can be helped by using 2 percent formaldehyde or by applying 2 percent salicylic acid ointment.

To minimize the rubbing of the foot by the shoe, wear two socks on each foot. In cold weather when the feet perspire less, friction may be minimized by dusting standard foot powder inside the sock.

Chafing between the toes is cured easily by cleanliness (a small wedge of cotton separating the toes) and the application of foot powder.

Corns are treated by salicylic acid collodion or ointment applied nightly after a hot foot bath; usually after four or six applications the corn can be removed easily with curved scissors.

Keep your hair clean and cut short.—Food workers should wear a cap whenever preparing or serving food or cleaning the galley or washing the dishes.

Brush your teeth after meals and before retiring.—In brushing your teeth, brush the up teeth down, and the down teeth up. That is, brush the outside surfaces away from the gum and toward the cutting surfaces. Promptly remove particles of food between the teeth preferably by the use of dental floss following meals. Have your teeth inspected twice a year by the dental officer, or immediately in cases of bleeding gums or pain.

Wear clean clothing.—Make sure your clothing is of the proper type and weight for the climate and nature of work. Your clothing should not fit tightly. Change shirts, underwear, and socks daily; wash them with soap and water and dry them in the sun if possible. If water is not available, clothing should be crumpled up, shaken well, and exposed to the sun and air. Change wet clothing (particularly shoes and socks) as soon as possible. Dry your clothing before putting it away. Any clothing that is wet with perspiration should be dried, and if possible, washed before storing. Avoid unnecessary exposure to extremes of weather and do not rest in drafts when perspiring or while your clothing is damp. Do not sit or lie directly on damp ground.

Neglect of personal cleanliness may encourage vermin such as body lice, "crabs" (pubic lice), and head lice. These produce itching, discomfort, and disturbed rest in the persons carrying them. The body louse can transmit serious diseases. Men having a persistent itching on the body or head or who see a louse on themselves or clothing should consult a medical officer at once. It is simple to destroy them with DDT powder. A clean body and a frequent change of clean clothes will in most cases avoid this infestation.

Keep regular.—Proper elimination is necessary to rid the body of wastes. Acquire the habit of a regular bowel movement once each day. Preferably at the same time each day. The habitual use of laxatives is condemned. Occurrence of any marked change in your bowel habits or bleeding from the rectum should be reported to your medical officer immediately. Any food worker who develops "loose bowels" or "cramps" should report immediately to his medical officer.

Exercise.—Proper exercise hastens the elimination of waste products from your body. It increases deeper breathing and perspiration; it also stimulates the circulation to the muscles and the heart which are nourished by more rapid metabolism. It improves all the other functions of the body, digestion, and even the resistance to certain diseases. It will increase your muscle tone and physical endurance. Exertion to the point of mild fatigue is wholesome, but if carried to the point of exhaustion, it may be harmful.

Rest.—During sleep the body recharges its nervous energy, repairs damaged cells, and regains its bounce. Sleep in a well-ventilated place. Sleep at regular hours, undisturbed, and long enough to awaken refreshed, free from fatigue. If ordinary sleep does not relieve your feeling of physical and

mental fatigue for several nights in a row, ask your medical officer about it.

Fresh air and sunshine.—These are essential for good health and should be taken advantage of whenever possible. Whenever you can, when at sea and working in areas below decks get up on top side, and sun bathe as often as possible.

Keep happy.—Your mental attitude has a close relationship to your health. Learn to adapt yourself to various situations pleasantly. Always be agreeable with your shipmates and accept orders willingly. This makes your life in the navy happier and healthier. The well-balanced man carefully complies with rules and regulations designed for his protection and that of his mates. He takes annoying and irritating situations in stride. He pushes aside worry and doesn't brood over minor matters. And he looks back on his problems as though they were but trifles. In short, he does not let his emotions rule his life. But rather he is the master of his emotions and his feelings.

So when faced with a difficult situation or problem don't give up, but work hard and find a reasonable solution.

One of the earmarks of a healthy mind is to be tolerant of the opinions of others. Have respect for what your fellow shipmates and officers say.

To keep happy and healthy one must work and be active. But do not be an all-work-and-no-playman. For you know "all work and no play makes Jack a dull boy" so you need recreation and hobbies as mental tonics (fig. 356).

Figure 356.—Mental Hygiene.

So develop a sense of humor. Be cheerful and friendly. Dispel depressing thoughts. A smile is one way to relieve tension. And laughter is a real tonic to take us over the rough places in life.

NUTRITION FOR HEALTH

A full stomach is no measure of the nutritional adequacy of a meal. Every day in the United States untold numbers of people are actually starving their bodies in spite of the fact that ordinary hunger is unknown to them. A few years ago the Surgeon General of the United States Public Health Service, Dr. Thomas Parran, said, "Nine-tenths of our malnutrition is under the surface." Dr. Parran was not speaking of that degree of malnutrition which produces an obvious nutritional deficiency; for example, beri-beri, pellagra, scurvy, or rickets. He was referring rather to a condition of "hidden hunger" which shows itself in such symptoms as lack of appetite, lassitude and chronic fatigue, loss of weight, lack of mental application, loss of strength, history of sore mouth or tongue, chronic diarrhea, nervousness and irritability, burning or prickling of skin, abnormal discharge of tears, muscle and joint pains, muscle cramps, sore or bleeding gums, and sores at corners of the mouth. It is steadily becoming more and more apparent that illness results not only from the presence of foreign bodies or germs in the body but also from the absence of those materials which must be supplied to the body for its maintenance and to build its defenses against the invasion of germs.

Proper nutrition is a personal matter that each individual must maintain if he wishes to have vital, buoyant physical and mental health.

See chapter V for detailed treatment of nutrition and its relation to health.

GROUP PROTECTION AGAINST DISEASE

There are six links in the chain of infection before any disease can develop:

1. Causative agent.
2. A reservoir or source of the agent.
3. A mode of escape from the reservoir.

4. A method of transmission.
5. A mode of entry into the host.
6. A susceptible host.

A break in any one of these six links will prevent the disease. For example, proper food and sanitation will destroy the harmful agent or prevent its transmission to a susceptible person (fig. 357). Vaccination makes the host less susceptible, thus breaking the chain. Mosquito control prevents the transmission of parasites from the insect reservoir to the susceptible host.

MAINTENANCE OF SANITARY MESS FACILITIES IN FIXED INSTALLATIONS

Food can affect health as the result of causative agents such as:

1. **Natural poisons** in it, such as certain mushrooms, and poisonous fish.
2. **Animal parasites** or their eggs or larvae may be contained in foods such as meat and fish.
3. **Bacteria** may be conveyed by animal or vegetable foods. This includes the tubercle, typhoid, paratyphoid, and dysentery bacilli.
4. **Toxins** may develop in foods as the result of bacterial growth. This includes the preformed toxin of staphylococcus food poisoning and botulism.
5. **Special poisons** are contained in foods such as solanin in sprouted potatoes.
6. **Chemical poisons** may accidentally be added to food, such as arsenic, lead, acids, insect powders.

Food poisoning can cause acute attacks of illness in more men in a short time than any other condition. The term "food poisoning" includes food intoxication and food infection.

1. **Too little or too much** food is also damaging to the body.
2. **Composition.**—The menu may be unbalanced causing vitamin deficiencies.
3. **Poor digestion** or disturbances of metabolism.

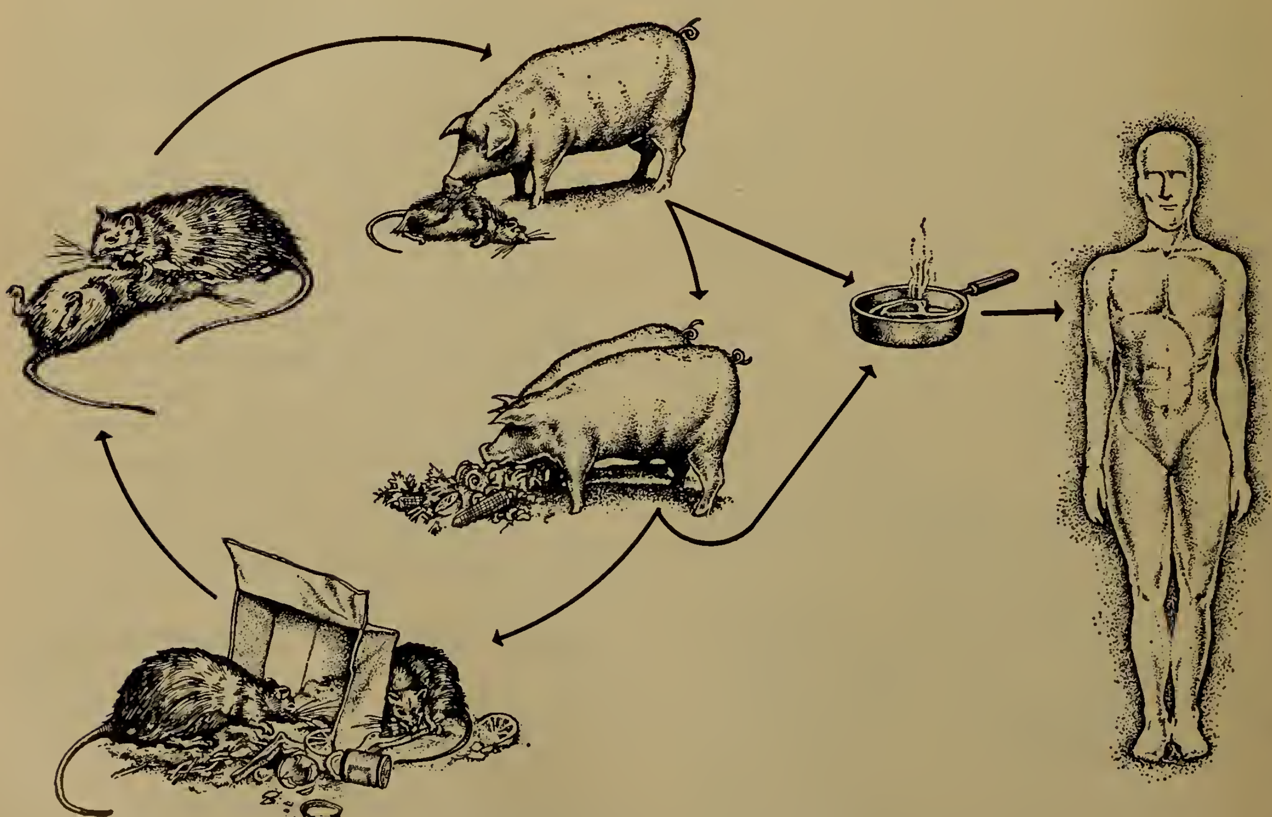

Figure 357.—Transmission Cycle of Trichinosis.

4. **Sensitivity** or an idiosyncrasy to certain foods.

Food intoxication is due to specific toxins produced outside the body, for example the toxin of *C. botulinum.* Botulism is no longer a problem except in home canned vegetables and meats. Other organisms can cause intoxication by producing toxins, the exact nature of which is not understood. These toxins are formed under suitable conditions, usually by staphylococci, streptococci, less commonly by coliform and organisms. The symptoms of food intoxication caused by other than *C. botulinum* are similar to those due to food infection i. e., nausea, vomiting, and diarrhea. The time interval of onset is shorter—one hour to six hours—vomiting is more violent, prostration is more severe, there is usually less fever and recovery is more rapid.

Food associated with such outbreaks varies. Ham is one of the most common foods involved in food intoxication. Others include canned or potted meat or fish, pressed tongue, beef, cheese or milk products, potato salad and macaroni salad.

The usual source of the bacteria causing food intoxication is from boils, pimples, and infected cuts on the hands of the food service workers.

The entrails of fowl contaminating the butcher's block or cutting table is another common source. Food may also be infected by flies, cockroaches, rats, mice, and polluted water when used in cooking and preparing food.

Besides the toxins or poisons produced by bacterial growth certain foods are inherently poisonous. Toadstools, hemlock, mussels in California during the summer, tropical fish, such as toadfish, puffer fish, and at certain seasons of the year barracuda are poisonous. When eaten they produce such symptoms as weakness or paralysis, numbness, tingling of the ears, apprehension, and possibly death.

Metallic poisons may be arsenic from residues of spray on fruit, or cadmium or zinc dissolved by acid foods such as lemonade, jello, tomatoes, etc., from cadmium-plated or galvanized iron cans. Ice trays in refrigerators are particularly dangerous if they are cadmium plated. Metallic poisons generally cause violent nausea, vomiting, and diarrhea very shortly after ingestion.

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Food infection.—This includes a specific group of organisms namely, the Salmonella group which cause illness characterized by fever, nausea, vomiting, diarrhea, abdominal pain and prostration. Symptoms begin 6 to 48 hours after eating the infected food. The causative organism may be revealed by examination of the vomitus and feces.

Major outbreaks of salmonellosis are caused by meat and meat mixtures. The meat may come from an animal infected during life with a specific organism, or may come from a healthy animal which has been infected during the process of slaughtering and handling.

Such sources of infection are best controlled by meat inspectors at slaughterhouses. Food service workers with hands not thoroughly washed after leaving the toilet are sometimes the source and the means of conveying contamination to food.

Foods which cause food poisoning are: Mixtures of meat such as ham, hash, meat or fowl, veal, and cream pies. Others are meat, crab, lobster and chicken salads, hamburger steaks, and cold sliced meat. Veal mixtures are a frequent source. Ham is most commonly infected with staphylococcus because of the common practice of boning and slicing it hours before serving.

The reason food is a possible source of disease is that it makes such a good medium for the growth of bacteria. Often foods are prepared and then stored in a warm place for several hours, in some cases overnight, and later served without adequate recooking. If they have been infected with one of the causative organisms, the warmth, moisture and protein present are favorable to bacterial growth and the production of toxin.

Remember that the bacteria causing a food infection does not always change the appearance, odor, or taste of the food and contamination by these bacteria is often unsuspected until after the outbreak of nausea, vomiting, and diarrhea has hit the ship's personnel.

When filling cream puffs, cream pies, custards, and various sauces made from milk and cream, remember to keep them refrigerated as these have caused many outbreaks of food poisoning. Do not mix salads by hand if the salad dressing or other ingredients will be favorable to bacterial

growth. All foods of this type should be kept under refrigeration until served.

Milk is one of man's most important foods, but at the same time it can be the means of transmitting diseases such as bovine tuberculosis, typhoid and paratyphoid fevers, diphtheria, scarlet fever, septic sore throat, undulant fever, dysenteries, and other diarrheal diseases.

Milk is a natural culture medium for bacteria. It decomposes readily and is probably the most difficult of all foods to obtain, handle, transport, store, and deliver in a clean, fresh state. Contamination of milk with disease-producing bacteria is often brought about by improper handling. Ladling individual servings from large containers is most dangerous and should be prohibited. The preventive measures are scrupulous cleanliness in milk production.

The preventive measures for keeping milk safe are:

1. Scrupulous cleanliness in production methods.
2. Immediate chilling of milk.
3. Keeping it clean and cold until consumed.
4. Bacterial count is the most reliable test to determine milk purity and cleanliness. Milk is graded chiefly on its bacterial count.
5. Milk should be pasteurized and grade A.
6. Milk should be delivered in bottles or containers approved by the Bureau.

Milk Pasteurization.—There are two recognized ways to pasteurize milk: (1) The holding method, and (2) the flash method. In the holding method of pasteurization every particle of milk is heated to a temperature of not less than 143° F. and held at such temperature for not less than 30 minutes in an apparatus of approved design, properly operated. The milk is then rapidly cooled to a temperature of 50° F.

The flash method is to heat every particle of milk to 160° F. and hold for 15 seconds and then rapidly cool to 50° F.

FOOD PROCUREMENT, STORAGE AND PREPARATION

To prevent food infections all possible sources of infection should be eliminated. Meats should be procured only from carefully inspected slaughterhouses. Cured as well as uncured meat should be properly refrigerated. No food, especially meat mixtures, should be prepared and set aside to be served at a subsequent meal. The time between the preparation and serving of food should be reduced to a minimum.

If it becomes necessary to hold over food, it should be put in shallow pans in the refrigerator and kept cold until it is served.

Refrigeration storage must be watched to assure free circulation of cold air to all sides of the stored food.

Experience shows that sandwiches containing meat, fish, fowl, or meat products that are to be served several hours after preparation should not be used unless kept under constant refrigeration.

If made from canned meat or meat products the sandwiches should be prepared only by opening the can immediately before serving. If galley-cooked meats are used the sandwiches should be prepared in the galley and kept constantly refrigerated during the time prior to serving.

Unopened cans of meat and meat products with the necessary bread can be sent ashore for sandwich preparation by beach parties just before serving.

Remember, every time food is taken from the refrigerator and left out for awhile, bacteria multiply until it is returned to the refrigerator. There is a definite relationship between the length of time it is left out and the amount of poison in the food.

A high standard of sanitation in the galley and butcher shop is important. The personal cleanliness and freedom from infection of the cooks and other food workers should be looked into, particularly to make sure they wash their hands after visiting the toilet. They should be watched constantly for symptoms of intestinal disturbance. No one should be allowed to prepare food who is suffering from any gastrointestinal upset. After an attack of dysentery, a food handler should be excluded from the galley for one month or until bacterial examinations show him to be free from dysentery bacteria. Typhoid and streptococcal diseases can be spread through a food service worker who is a carrier.

Typhoid is transmitted by vermin—flies and roaches—that may walk on the excreta of typhoid victims and then walk on food. It goes without saying that all vermin should be eliminated from galleys and from any place where food is kept or prepared.

Typhoid can also be contracted from shellfish taken from contaminated waters (especially around large cities or ports). No shellfish should be eaten raw.

Outbreak investigation.—Immediately after a food poisoning outbreak get samples of the last meals served to be examined by the laboratory. As soon as care of the sick permits, an epidemiological study of the outbreak should be undertaken.

Patients should be questioned regarding the foods eaten.

Unaffected members of the same mess should be interrogated as to whether they ate the same food.

By careful study of the information obtained, a fairly accurate idea of the food responsible for the outbreak will be found. By the nature of certain foods they will be suspected while others will not.

If some men are affected yet did not eat the suspected food that food should be ruled out.

Specimens of the suspected food and of the urine and feces from the more typical cases should be collected and sent to the nearest clinical laboratary for examination. Such outbreaks must be reported to the Bureau of Medicine and Surgery in accordance with the Manual of the Medical Department and other current instructions.

Diseases associated with food poisoning.—Some diseases give digestive upsets similar to food poisoning. For example, amoebic dysentery usually appears after the ingestion of amoeba cysts and the appearance of symptoms may be as long as a year later.

Trichinosis symptoms may appear as early as 24 hours after the particular meal in which the larvae are ingested, but usually appear in about 9 days.

Ask if fresh pork, improperly cooked, has been eaten to rule out trichinosis.

Since there is no specific treatment for trichinosis, safety lies entirely in prevention. It is imperative that pork products be thoroughly cooked. Certain types of prepared pork for such foods as wieners are required to be refrigerated for a period of about 20 days before preparation.

Food specifications.—No food should be purchased that does not meet military or Department of Agriculture specifications (Bureau of Animal Industry), or a veterinary inspector of the Department of the Army or Air Force. The food procured for Navy exchange or civilian cafeterias, officers' or chief petty officers' messes or clubs should approximate the food procured under specifications for the general messes.

For more detailed information on inspection, serving of food and sanitizing equipment and utensils, see the Manual of Naval Hygiene and Sanitation, NavMed P–126, and Operation and Maintenance of Dishwashing Machines, NavShips 252–50.

Health and Hygiene of Food-Service Personnel

All food-service personnel must be given a physical examination prior to assignment to duties in food-service facilities. Special attention should be given this group since diseases arising from open sores or other communicable diseases can lead to serious outbreaks through food. Special attention should be paid to preventing any individuals having intestinal diseases or a history of such, skin infections, or any other subjective symptom of a communicable disease from working in the galley. The initial medical examination serves a definite purpose, but it by no means provides complete and continual protection against the presence of disease among the food-service workers. An individual with a disease in the incubation stage may be assigned duty in the galley. This disease may develop and cause other members of the group to become infected. If the disease is not checked, it is reasonable to assume that the illness will eventually be passed along to the crew of the ship or shore activity concerned.

When the hospital corpsman has the responsibility of supervising the sanitary condition of the food-service facilities, he must be ever alert for the appearance of infectious disease among the food

handlers. He may find it necessary to check these men every day and to recommend their removal from food-service work if any symptoms of communicable disease appear. He should pay particular attention to the general cleanliness of the group, noting especially the conditions of clothing, hands, and fingernails. The hands should be clean, and the fingernails should be clipped short. Efforts to educate the personnel in the basic principles of cleanliness and sanitation should be a fundamental and continuing part of the food-service-personnel training program.

Convenient toilet facilities with adequate supplies of soap and paper towels are essential to permit the food-service worker to maintain personal cleanliness. All food-service personnel shall be required to wash their hands thoroughly before leaving the toilet and should not return to the galley area to wash their hands, since they may spread pathogenic bacteria before accomplishing this essential detail.

Personnel engaged in serving food must be properly trained. The food-service worker must be dressed in clean outer clothing, including clean hat or other suitable head covering.

Material Cleanliness

The equipment used in preparing and serving food must be kept scrupulously clean. The equipment installed in galleys always requires considerable attention from a sanitation standpoint. Often spaces are left between fixtures and bulkheads or between fixtures and the deck. Usually these spaces are too small to provide room for easy cleaning; yet they are large enough to hide food scraps, broken glass, and other debris. Such accumulation of filth will serve as a source of food for rats and insects.

One of the biggest sanitary problems aboard ship, as well as in many shore installations, is the control of rats, who are capable of spreading disease. The presence of cockroaches indicates insanitary conditions; they are also capable of harboring and transmitting communicable diseases. Neither the rat nor the roach can exist without food; therefore they will not be found in well-kept, well-ventilated, clean food-service facilities.

Garbage should never be allowed to remain in the food-service facilities overnight to attract vermin but should be kept in a well-covered receptacle and removed to a separate compartment until it can be disposed of.

Fluid and solid waste should be separated so that the contents of the can will not become a semifluid mass of decomposing garbage. Separation can be accomplished by using individual containers, one for fluid materials and one for solids. Waste materials should not be heaped above the top of a container so that the garbage spills over the sides and soils the deck. If it does overflow, the deck should be cleaned immediately to prevent an accident hazard and the attraction of rats, roaches, and other vermin. The garbage container should be thoroughly cleaned and disinfected every time it is emptied.

Good lighting is an aid to cleanliness and to careful preparation of food. The bulkheads in the galley should be coated with a hard-surfaced material which is light in color and easily cleaned. The overhead is to be kept free from any peeling paint or other material which might drop into the food. Usually the deck slopes toward the drains so that swabbing with plenty of water can be accomplished easily. The deck should be cleaned very thoroughly once a day and preferably after each meal has been prepared.

As in the case of food-service personnel, continual inspections should be made of materials, dishes, and utensils used in preparing and serving food for maintenance of high standards of cleanliness in housekeeping, dishwashing, and storage. Continual training of workers in these subjects is also necessary.

Food Storage

Canned provisions.—Canned foods, with the exception of canned whole ham and dried beef, should be stored in dry, cool, well-ventilated spaces wherever practicable and should be placed on shelves or pallets not less than 8 to 10 inches off decks. It is desirable that they be so arranged that they are used in the order received and with reference to the date of packing to prevent undue aging of stocks on hand. Canned cooked whole

ham and dried beef are not sterile, are perishable, and should be stored in the chill room.

Dry provisions.—Dry provisions in general should be stored in a manner similar to canned goods, with the extra provision that ratproof containers or compartments be used wherever practicable. Bread should be protected against flies, roaches, mice, and rats. All bread should be kept, if practicable, in wax-paper wrappers until needed. When returned from the mess hall it is placed in a bread basket and covered to prevent fly contamination. All cereal foods should be closely observed for insect infestation at time of procurement to prevent infestation of present supplies. Opened cereal foods should be stored in clean suitable containers with tight fitting lids. It is extremely important to maintain excellent housekeeping standards where cereal foods are stored.

Fruits and vegetables.—Proper storage and temperature conditions will prevent much loss among foods of this type. Fruits and vegetables may be divided into three groups, as follows:

1. *Group I.*—Recommended storage temperature 32° to 33° F. and a relative humidity of 85 to 90 percent: apples, cranberries, grapefruit, oranges, pears, plums, prunes, beans (snap and lima), beets, celery, lettuce, parsnips, sweet peppers, rutabagas, and turnips.
2. *Group II.*—Recommended storage temperature 40° to 42° F. and a relative humidity of 85 to 90 percent: honeydew melons, onions, and Irish potatoes. Compartments in which potatoes are stored must be kept dark. Onions keep well in the dark at 32° F. and a relative humidity of 70 to 75 percent, but they should not be stored with Group I on account of their effect on the taste of such articles as apples and grapefruit.
3. *Group III.*—Recommended storage temperature 55° to 58° F. and a relative humidity of about 85 percent; lemons, sweetpotatoes, winter varieties of squash, and green mature tomatoes.

It should be remembered that the concentration of carbon dioxide developing from the respiration of vegetables and fruits in a closed compartment (such as the hold of a vessel) may reach a dangerous level; i. e., 5 percent or above. Deaths have been reported for men who descended into holds filled with fruit such as bananas. Such storage spaces must be properly ventilated to prevent an excess accumulation of carbon dioxide.

Dehydrated vegetables.—Dried vegetables are particularly useful during time of war because the shipping weight of the dried product is about one fourth that of the fresh product and the storage space is greatly decreased. Cold storage is not required for their preservation. Their storage life is limited to about 6 months at high temperatures.

ESSENTIALS OF HEALTHFUL LIVING CONDITIONS ASHORE AND AFLOAT

Heating and ventilation of enclosures for health and efficiency depend upon control of: (1) air temperature, (2) sufficient air supply and movement, (3) humidity, and (4) mean radiant temperature of surrounding surfaces. Adequacy of installations, including air conditioning and/or cooling, should be reviewed on the basis of these factors to determine whether the customary criteria have provided proper conditions. Improved facilities may be necessary and/or justifiable for health and efficiency.

Ventilation standards, aside from space allowances, are based upon the factors already discussed inasmuch as their control provides hygienic conditions so long as artificial contamination and dangers from noxious dusts, fumes, or other products of special processes are excluded. The outside air supply necessary is only that required to remove objectionable body odors, tobacco smoke or cooking odors. Observations should be made immediately upon entering an enclosure from fresh air outside, since the sense of smell is rapidly fatigued, or rapidly adjusts to local conditions. Otherwise the adequacy of ventilation is judged from the condition for comfort based on the combination of the air's temperature, humidity, and motion. This condition for comfort, however, may be modified by the factor of radiation from surrounding surfaces and objects.

The standard for natural light in buildings is 1 square foot of window space to each 5 square feet of floor space. Roughly, there should be one moderate-sized window for each bed in barracks and hospitals.

Sanitation of Quarters Afloat

The medical officer makes routine sanitary inspections of berthing spaces and toilet, lavatory, and bathing facilities. Judgment of applicable standards is based on careful consideration to the functional design of the ship, its military requirements, and the advantages deriving from a high standard of individual hygiene.

A berthing compartment shall have at least 16 square feet of floor space, 120 cubic feet of air space per man, and 3 feet minimal distance between the heads of sleeping men, using head-to-foot bunking arrangement. These dimensions should not be acceptable unless ventilation is adequate (10 to 30 cubic feet of fresh air per person per minute). Recommendation for proper ventilation is the responsibility of the medical department.

The medical department representative is charged with the responsibility of making recommendations regarding sanitary conditions aboard ship; in order to accomplish this task, he must make periodic inspections. In making a sanitary inspection, the medical representative, whether it be the medical officer or the hospital corpsman, must devise a regular procedure that will indicate to him whether his recommendations are being effectively carried out.

The medical representative should make an initial survey to determine the current sanitary conditions of the ship. This survey should include the following:

Food Supply

Determine the source of food supply used aboard the ship:

1. To determine the source of the food being consumed aboard a vessel, the medical department representative should have discussions with the commissary officer and the various caterers of the wardroom and other private messes.

2. Where fresh fruits and vegetables or foods of animal origin are purchased for the commissioned officers' and chief petty officers' messes, such sanitary supervision and bactericidal treatment shall be given as indicated.

3. The medical department representative should determine the adequacy of sanitary supervision of good housekeeping standards as well as of food preparation, storage, and serving. Such standards as are not covered in this Handbook are outlined in the Manual of Naval Hygiene and Sanitation.

Water Supply

The medical department representative should consult with the engineering force concerning the general practice and supervision afforded in taking fresh-water supplies aboard. Such a discussion should include information concerning handling and storing fresh-water lines, cleaning and disinfecting storage tanks, supervision and instruction afforded in operating the distillation plant, the presence, if any, of any cross-connection between potable and nonpotable water supplies, and the sanitary design and care of scuttlebutts. The potential hazards associated with ice machines should be closely observed. Standards pertaining to the maintenance of a safe water supply are contained in the Manual of Naval Hygiene and Sanitation.[1]

Berthing Spaces

The Navy is ever trying to improve shipboard living conditions. The important criterion of ventilation and air conditioning is the maintaining of temperature in berthing spaces at a maximum consistent with a favorable sleeping environment. Minimum berthing facilities to be provided and maintained are outlined in the Manual of Naval Hygiene and Sanitation and in the Manual of the Medical Department.

The Bureau of Ships has initiated a lighting-improvement program designed to give an increase in foot-candle level. This is effected through better arrangement of present fixtures, modification of standard lighting fixtures providing practically glareless illumination, removal of shadows, and more light output. Also fluorescent lighting, comparable to that in use ashore, has been adopted for extensive shipboard use to decrease heat and improve efficiency, and on newly constructed ships improved incandescent-type fixtures are provided in the ship's berthing spaces. Initial sanitary surveys must determine the general practices regarding sleeping alternately head to foot, distance between heads of sleeping men, and other general

[1] The use of salt or overboard water is prohibited in food preparation or cooking spaces.

standards pertaining to berthing as listed in the Manual of Naval Hygiene and Sanitation and/or the Manual of the Medical Department.

Toilet and Bathing Facilities

All new vessels will be provided with individual water closets to replace the trough now in use. Instructions have been issued for general replacement of troughs. The initial survey should determine whether or not facilities meet minimum requirements. Particular attention must be paid to eliminating cross connections between fresh-water and salt-water showers where such are used. Use of salt water for bathing purposes should be prohibited in harbors and on ship while in close formation.

CONTROL OF INSECTS AND CARRIERS

Flies

Among the most common diseases transmitted by flies are dysentery and typhoid fever. Flies may transmit diseases: (*a*) When they have access to human body discharge (feces, urine, sputum) containing infectious organisms, (*b*) when they have access to infectious materials on the external surface of the body; and (*c*) when they are able to bite and carry infection from one person or animal to another, as in African sleeping sickness and tularemia.

Flies are two-winged insects passing through four stages of development—egg, larva, pupa, and adult.

The housefly lays its eggs in vegetable or fecal matter that is about to ferment, grease-soaked soil, decaying bodies, blood, etc. The egg hatches into larva or "maggot" in 8 hours to 1 day. The larva changes into the pupa in 4 to 8 days, and 3 to 5 days later the adult fly emerges from the pupa. The entire metamorphosis requires 7 to 14 days or longer, depending on the weather and other conditions. It has been estimated that a single female fly can produce 810 young in a single season. The adult fly may travel a mile or more from its breeding place in search of food; it takes only liquid foods and regurgitates in order to dissolve solids, thus causing contamination. Disease organisms also are carried on the feet of the fly to food and mess utensils from contact with excrement and other filth.

Resistance to DDT.—In the field, housefly resistance to DDT may be a significant problem. In many areas satisfactory control with DDT is no longer practical and in some cases substitution of newer, more potent insecticides has been successful for only limited periods. On the other hand, the majority of military installations in the United States have not yet found DDT noticeably ineffective for fly control. This may be explained by good sanitation programs that limit fly populations and breeding rates and by relatively less heavy applications of DDT over wide areas. Localities in which a high degree of resistance to all insecticides has developed are most uncommon at present: but, when this situation is encountered,

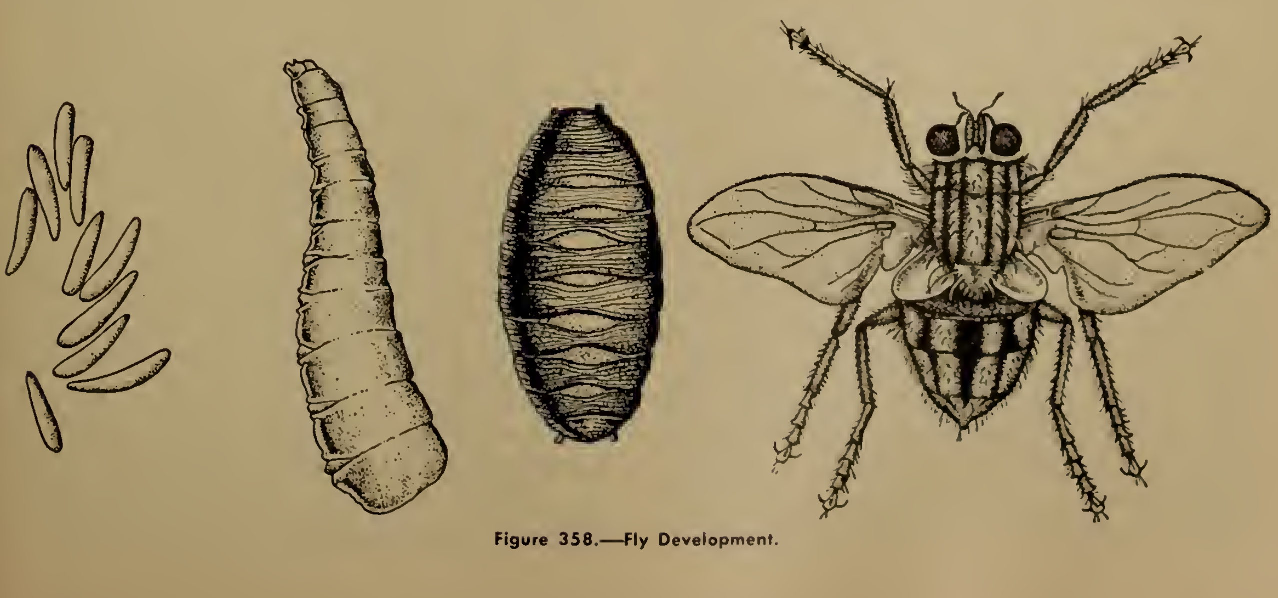

Figure 358.—Fly Development.

dependence on nonchemical methods will be necessary until effective new materials are developed.

The following policy on fly control is recommended:

Prevention of fly breeding.—An extensive sanitary program designed to eliminate fly-breeding sources and to reduce the use of chemical controls to the minimum should be routine, whether or not resistance has developed. Incineration of all garbage and refuse or sanitary fill dumps should be considered as essential as sewage disposal facilities at all permanent installations.

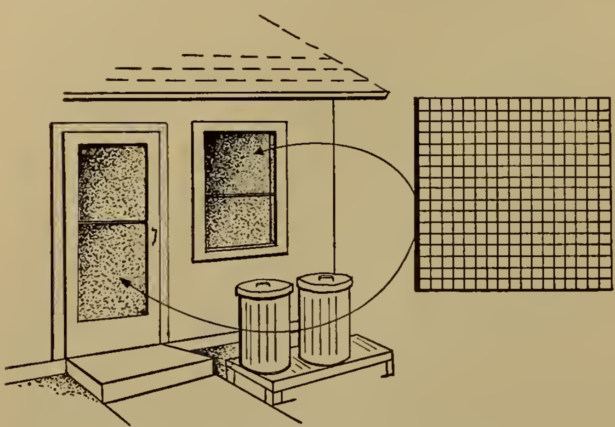

Figure 359.—Prevention of Fly Breeding.

Access of flies to food, mess gear, kitchens, mess halls, living quarters, and excreta must be prevented. In a permanent camp the kitchen, mess halls, garbage cans, and latrines should be tightly screened. Screens should have a mesh of 18 wires to the inch. This will also keep out mosquitoes. In a semi-permanent camp, screening may be impractical; consequently, dependence must be placed upon cleanliness and insect-proof containers. In the absence of metal screening, mosquito netting, target cloth, or similar material may be used to flyproof tents, galleys, shacks, etc. Screen doors should be made to open outward and fit snugly and should be in direct sunlight when practicable.

Fly breeding in human excreta is particularly dangerous, hence latrines, wherever possible, should be carefully flyproofed. In temporary camps, enforcing the use of straddle trenches and the prompt covering of feces are extremely important. Garbage should be kept in covered containers and should be removed frequently, especially in warm weather. It may be burned, buried, or dumped at sea some distance off shore. The use of a sanitary fill is an effective method of permanent disposal of inedible garbage, nonsalvable waste, and rubbish. Grease traps must be covered and the surroundings kept clean and dry, or fly breeding will occur.

Destruction of flies.—Where preventive measures cannot be fully applied or are not adequate to control the fly population and resort to insecticides is necessary, the following procedures should be followed in the order presented. Succeeding steps should not be taken unless previous measures are found inadequate. .

1. Apply space sprays to enclosed or screened areas only. Insecticide (liquid) Standard Stock No. 51–I–165 may be applied with hand or power sprayers or aerosol generators.

2. A 5 percent solution of DDT in kerosene or DDT as an emulsion should be applied to all screens on doors and windows with a sprayer or paint brush. The residual DDT thus applied acts as a contact insecticide, killing flies for as long as 2 or 3 months after application. Five percent DDT in kerosene should be applied in the proportion of 1 quart to 250 square feet to interior surfaces of walls and overheads in latrines, mess halls, barracks, and other places where flies congregate. Residual treatments will be effective for several weeks or months in killing houseflies.

All exposed utensils and food should first be covered and men should wear charcoal-type respirators and gloves. DDT in oil must not be allowed to come in contact with the skin; it is readily absorbed and presents a health hazard. DDT is a nervous-system poison but can cause damage to other tissues and organs as well. Where DDT resistance has been fully demonstrated, lindane may be substituted. Lindane should be applied only when its use is recommended and supervised by specially qualified and designated personnel.

3. Insecticide applications to outside areas may be applied if necessary, but at permanent bases should be limited to small-particle fogging treatments with DDT when this insecticide is effective; otherwise, lindane or chlordane may be used.

4. When breeding areas cannot be eliminated by sanitary methods, they may be treated with 2 percent chlordane, Standard Stock No. 51–I–155–375. Manure, ground, and enclosures around latrines,

garbage racks, and any other places subject to fly breeding should be covered with the spray at a rate of about 1 quart to 200 square feet.

5. An immediate change to new and more powerful insecticides merely on suspicion that DDT resistance may be present is not recommended. Where resistance is suspected a report should be made to a Fleet Epidemic Disease Control Unit, a Preventive Medicine Unit, or the Bureau of Medicine and Surgery, so that action may be initiated to study the extent and degree of resistance and to recommend control plans.

6. Other methods of fly control that may be advantageous are the use of flypapers, flytraps, and poisoned baits. Sweetened solutions of formaldehyde (1 percent) or sodium salicylate (1 percent) will kill flies. These solutions should be placed where food will not be contaminated.

Mosquitoes

Mosquitoes rank first among all insects that jeopardize the health of man. The three important genera concerned are Anopheles, Aedes, and Culex. The most important diseases transmitted by mosquitoes are malaria, dengue, yellow fever, filariasis, and encephalomyelitis.

Personal Protection

Three 2-ounce bottles of insect repellent should be made available to each man per month in areas where mosquito-borne diseases occur. Twelve to fifteen drops of repellent are placed in the palm of the hand; and after rubbing the hands together, one should make an even application to all exposed skin surfaces. Care should be taken to avoid mucous membranes. The repellent usually persists for about 3 or 4 hours, but the duration is shortened by such factors as rain and perspiration. Dimethyl phthalate, supplied in 1-gallon containers, may be applied undiluted to clothing with a spray gun. Clothing may be treated while being worn if the wearer covers his eyes to protect them. Two ounces are sufficient to treat one uniform completely when treated after removal from the body. This treatment prevents mosquito bites through garments for a period of a few days. Improved standard repellents and clothing impregnants that are effective for much longer periods will soon be available.

Long sleeves and trousers should be the required uniform after sundown in malarial areas. In addition head nets, gloves, and leggings should be worn. Bed nets must be used by all personnel in areas infested with disease-carrying mosquitoes. Living quarters in permanent or semipermanent camps should be screened by using wire having 18 meshes to the inch.

In malarious areas access to native villages should be restricted from sundown to sunup. Anopheline mosquitoes are mainly night biters. On the other hand, many of the culicine vectors of dengue fever and filariasis are daytime biters, and native settlements in which these diseases are prevalent should be avoided at all hours of the day or night.

Adult mosquito control.—Adult mosquitoes may usually be destroyed by spraying or painting screens and the interior of quarters with DDT. A 5 percent solution of DDT in kerosene or as an emulsion should be applied at the rate of 1 quart to 250 square feet of interior surfaces of walls and overheads. A 5 percent preparation of wettable DDT applied at the rate of 1 quart to 250 square feet of surface is also effective. In some areas, where the mosquitoes do not rest on interior surfaces for long periods, these residual treatments are not effective. Adult mosquitoes in tents, huts, shelters, and buildings may be killed through the use of the aerosol bomb.

About 4 to 5 seconds' spraying is required for 1,000 cubic feet of space, if the room is not ventilated.

Airplane dispersal of DDT solutions is an effective and rapid method of spray killing adult mosquitoes over large areas. The method is particularly useful during the early phases of occupation before organized spray killing of adult mosquitoes or larvicidal operations on the ground can be initiated. A solution of 10 percent DDT in diesel fuel oil (using an auxiliary solvent) generally gives good control of mosquitoes when applied at the rate of one to two quarts per acre.

The distribution of DDT or BHC aerosols (insecticide smokes) by ground equipment is also a good method for rapid elimination of adult mosquitoes from large areas. This method is limited, however, by dependence on favorable wind and weather conditions.

Figure 360.—Larvae and Adult Mosquitoes.

Control of immature stages.—Larvicides often must be relied upon not only during the early phases of a program before drainage and other permanent measures can be initiated, but also for periodic treatment of persistent breeding places. The most efficient larvicide is DDT, either in oil solution, as an emulsion, or as a dust. One quart of diesel fuel oil containing 5 percent DDT or 5 quarts of oil containing 1 percent DDT is sufficient to treat an acre of water surface. This rate provides one-tenth pound of DDT to the acre and is adequate for from 6 to 9 days. The same amount of DDT per acre is required when the emulsion or dust is used. One to two quarts of 5 percent solution (smaller amounts of 10 to 20 percent solution) are required per acre for larval control by aircraft. Where mosquito resistance to DDT has been demonstrated, benzene hexachloride may be used.

Heavy doses of DDT will kill fish and other aquatic fauna. Fog generators or mist blowers mounted on trucks or trailers have been used with considerable success in the control of mosquito larvae and adults where areas are accessible to motor vehicles. Diesel fuel oil or grade F. S. No. 2 fuel oil without DDT is effective, although 20 to 30 gallons of oil per acre are needed to form a thin, continuous film. The "Panama dripper" consists of an oil can with a faucet near the bottom which allows the oil to fall on the water, drop by drop (usually at the rate of about 30 drops per minute), and permits continuous oiling of a running stream. Drainage and filling are also efficient measures. Where the mosquito-breeding area is below sea level and cannot be drained, it may be flooded with salt water to prevent breeding. In other areas deep ditches may so reduce the water surface that it may be easily controlled by oiling. Small swamps, marshes, and other low areas may be filled in with dirt, ashes, or other material. Comparatively small amounts of stagnant water in pools, barrels, tin cans, or other man-made breeding places furnish sufficient breeding surface to infest a camp with *Culex* and *Aedes* mosquitoes. In the selection of a camp site, proximity to native habitations should be avoided.

Lice

Ten percent DDT powder is more effective and longer lasting than any previously known louse treatment except where strains of lice resistant to DDT occur. For the body louse the entire inner surface of the undergarments is dusted lightly, with special attention being given to the seams. The inner seams of the trousers and shirt should be rubbed slightly by hand to spread the powder more evenly. The application is repeated at 1-to 2-week intervals, depending on the abundance of the lice.

For head lice the powder should be rubbed thoroughly into the hair. It should also be dusted in the hat or other headwear. An additional treatment is suggested 1 week to 10 days later to kill the hatching young. Crab lice are killed by dusting the powder over the infested areas and rubbing it in thoroughly.

Other effective louse powders will usually be made available in areas where DDT-resistant lice are known to occur. In the absence of effective powders it will be necessary to depend on the following control methods:

Ironing of clothes will kill both the adults and the eggs; steam heat will accomplish the same purpose. The "sack disinfestor" is one simple method of using steam heat in the field. Clothes and other articles may be disinfested by this means. The sack disinfestor depends on the principle that steam entering the upper portion of the inverted bag displaces the air in its course downward and produces an extra atmospheric pressure (about 15 pounds per square inch), which pressure in turn raises the temperature of the interior of the sack to 107° C. The sack disinfestor is useful for disinfection and disinfestation.

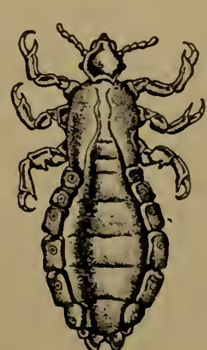

Figure 361.—Adult Body Louse.

Fleas

This insect may transmit plague and murine typhus. The adults feed on the blood of animals, and the larvae develop in organic refuse in the ground, floor cracks, litter, upholstery or under rugs, and in nests of rodents. Repellents should be used in areas where flea-borne diseases are present. They may be used in the same manner on the skin and clothing as when used against mosquitoes. Rats and other small animals which harbor fleas should be destroyed. Dogs can be disinfested by treating with 10 percent DDT dust, well rubbed into the fur. Cats should not be treated with DDT because they lick themselves and are especially sensitive to DDT. Derris or pyrethrum powder can be safely used on cats and is effective for fleas.

Figure 362.—Adult Human Flea.

Five percent DDT in kerosene has been found effective against fleas in buildings. The sprays should be applied to the floor and about 2 feet up the bulkheads at the rate of 1 quart per 200 to 400 square feet. The dosage must be considerably higher on earthen floors for the DDT particles become covered with dust, making them unavailable for contact with fleas.

DDT should be used in rat harborages for plague control where cyanide dust may not be utilized.

Chlordane is even more effective than DDT and may be used as a 2 percent spray applied to floor areas, except in living quarters, at the rate of 1 gallon for each 750 square feet. Outdoors 10 to

20 gallons per acre of 1 percent chlordane may be applied to infested grounds and under buildings. Lindane or Benzene Hexachloride may also be used when authorized and supervised by qualified personnel and should be substituted for chlordane in living quarters and mess halls. Strains resistant to DDT have been reported.

Ticks

These insects transmit Rocky Mountain spotted fever, relapsing fever, boutonneuse fever, and cause what is called tick paralysis. They cling to bushes, leaves, and grass and attach to animals or humans in search of a blood meal. Protective clothing is important in avoiding ticks. Never sleep in clothing worn outdoors. Repellents of a new type are effective against ticks.

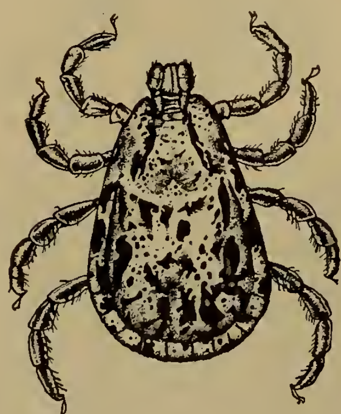

Figure 363.—Wood Tick (Common).

Personnel should pair off and inspect each other every 4 hours, removing ticks by gentle traction (preferably with forceps). Application of chloroform, kerosene, repellent, or a lighted cigarette causes ticks to release grasp. Avoid crushing ticks as the body fluid may be dangerous. Mice, rats, and other small animals should be destroyed.

Benzene Hexachloride or chlordane is recommended for area control of ticks. Ten to twenty gallons of a four-tenths percent Benzene Hexachloride spray or a 1 percent chlordane spray should be applied to ground litter and low vegetation at a rate of 10 to 20 gallons per acre. DDT has given good tick control in some areas when applied to the margins of trails and roads at a rate of 3 pounds per acre.

Mites

Parasitic mites are the cause of scabies and certain other skin irritations of man and animals. The larval stages of other mites also transmit scrub typhus, endemic typhus, and epidemic hemorrhagic fever in various parts of the world. In the United States, chiggers, also called red bugs and harvest mites, frequently cause severe discomfort and annoyance to troops in the field.

Control of mite infestations may be accomplished by elimination of the rodent hosts from the area to be inhabited by troops. Underbrush, vines, and bushes should be cleared and all debris burned or removed. Vegetation and surface dirt may be scraped off with bulldozers. Area treatments with residual miticides are also effective. A four-tenths percent Benzene Hexachloride or 1 percent chlordane spray applied to ground litter and low vegetation at the rate of 10 to 20 gallons per acre is recommended. Protection of personnel in the field will require the use of standard repellents.

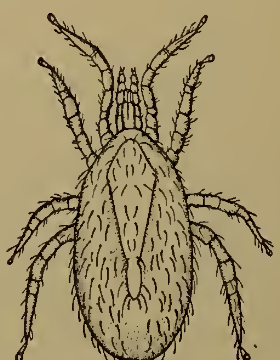

Figure 364.—Tropical Rat Mite.

Bedbugs

The most effective insecticide for the control of bedbugs is DDT. It may be applied as a 5 percent dust, in an emulsion, or in kerosene. Care must be taken to apply the material to bedsteads, springs, mattresses, and to the floors and walls near the bed, especially all crevices in which the bugs may hide during the day. The DDT–kerosene mixture or emulsion (if emulsion is used, ventilation should be ample) should be applied in a spray in sufficient quantities to obtain a heavy, even deposit of DDT. Barracks so treated have been found to remain free from bedbugs from 4 to

10 months. Smoking should be prohibited during treatment and for 12 hours thereafter. All fires should be put out.

Other measures against bedbugs:

a. Air bedding in the sun frequently.

b. Bedbugs and most other pests can be killed by a temperature of 120° to 125° F. This temperature must be maintained for 24 hours.

c. On ships and stations where large sterilizers are available, turned-in mattresses and pillows may be run through the sterilizers before being placed in the storeroom. Where there is any indication of vermin in the quarters, all mattresses and pillows should be sterilized periodically.

d. The advent of DDT has made fumigation for bedbug control no longer necessary.

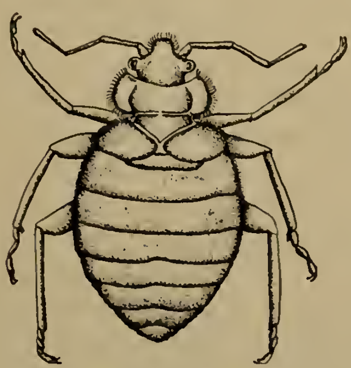

Figure 365.—Bedbug.

Cockroaches and Ants

Cockroaches are widely distributed, and the degree of infestation is usually associated with sanitary conditions. Good housekeping, the elimination of hidden spaces and crevices where food particles can collect, and adequate protection of food supplies have a marked effect on the effectiveness and need for insecticide applications.

Figure 366.—Black Ant.

Chlordane and lindane are more effective against roaches and ants than DDT. The 2 percent (Standard Stock No. 51–I–155–375) is a solution in kerosene oil and is recommended for use in control of roaches and ants indoors and for ant and fly breeding areas outdoors. For the control of roaches application of chlordane solution (2 percent by weight in deodorized kerosene) should be made at an approximate rate of 1 gallon per 1,000 linear feet of cracks and crevices or 1 pint per 125 lineal feet. The best way to gauge the proper amount of chlordane (2 percent formulation) is to spray until surfaces are wet without run-off. The spray should be applied freely to cracks, crevices, niches, spaces in bulkheads, and equipment where roaches harbor. One application has often been effective for several months. For ants indoors the solution should be applied to areas frequented by ants, particularly to wall cavities from which ants emerge. Their runways and nests should be sprayed outside and beneath the buildings. Oil solution applied at the rate of from 1 tablespoon to 1 pint poured directly on the ant hills is effective against subterranean species.

Figure 367.—American Cockroach.

Chlordane must not be used for residual applications which cover entire surfaces in living quarters and mess halls or as an interior space spray where personnel are present. As with all insecticides, contamination of foods and utensils must be prevented by protective covers and proper direction of sprays. In case of spillage on the skin immediate washing with soap and water is necessary. During its application ample ventilation must be provided.

Rodents

Navy rodent-control procedures are directed against the transmission of diseases such as plague, endemic typhus fever, and Weil's disease to naval personnel and against destruction, damage, and contamination of stores by rodents. These objectives are effected by means of ratproofing ships and shore structures, the use of rat guards, proper stowage of foods and other stores, poisoning, trapping, and fumigation.

Hospital corpsmen and officers trained in rodent control are to be found in most major naval commands afloat and ashore. Current directives from Chief of Naval Operations, BuMed, and from local commands outline policies in connection with rodent-control operations and the handling, use, and stowage of highly toxic rodenticides.

Personnel engaged in rodent-control work soon learn to estimate the extent of infestation aboard ship and on shore by signs left by rodents. These include dirty streaks along rat runways, rodent droppings or fecal pellets, the amount of gnawing through wooden doors, bulkheads and packaged stores, and less frequently the actual observation of live rats or mice.

Trapping is best accomplished by means of snap guillotine traps, baited with a food material determined by observation to be attractive to the local rodents. Often traps are used unbaited by enlarging the trigger surface with a piece of light metal or cardboard 2 to 3 inches square. In any case traps should be set in runways, so that rats may be caught while running over the trigger mechanism. Traps should always be secured to a heavy or immovable object to prevent their being dragged away. Traps may be secured to overhead pipes, among stores, and in innumerable places where rats are evident. It is frequently desirable, particularly outdoors, to invert a box with two openings, for access and egress, under which a baited trap may be set. Such a box takes advantage of the preference which rats show to eat under cover. Two openings are necessary since rats dislike such a cover unless there is one opening to come in, another to go out. This type of shelter is also used in prebaiting and poisoning discussed in a following paragraph. Cheese ordinarily is not a good bait. Preferred baits are meat, fish, raisins, and fleshy food materials which can be securely attached to the trigger. Hair-trigger settings are most successful.

Fumigation with hydrocyanic gas is not permitted aboard U. S. Navy vessels unless necessity

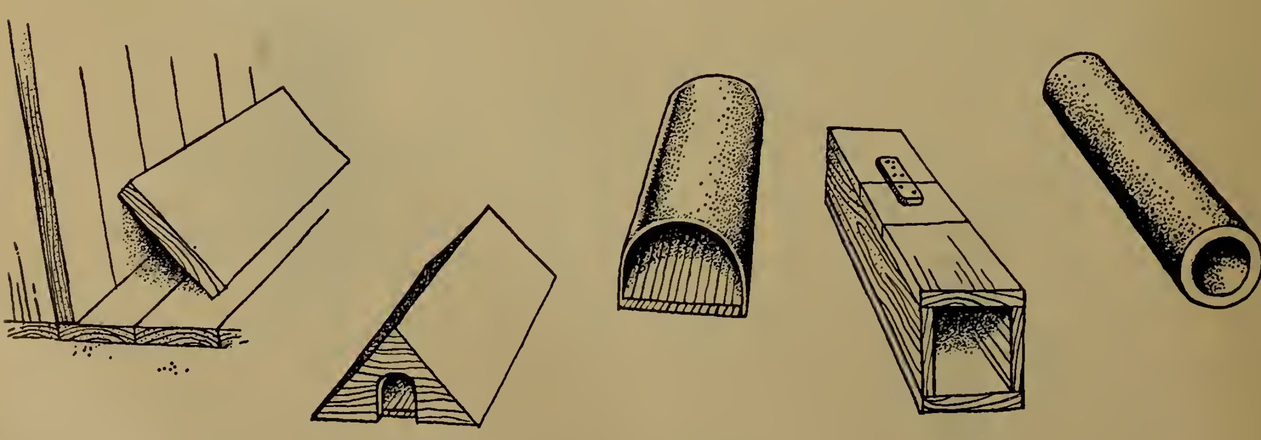

Figure 368.—Bait Boxes.

is determined by the U. S. Public Health Service. It is a dangerous procedure and requires that all hands leave the ship during the operation. Hydrocyanic acid gas does find use in the form of calcium cyanide dust which is blown into rat burrows, on garbage dumps and in similar locations by foot pumps or blowers designed for that purpose. In handling cyanide compounds, one should remember that they are highly toxic to human beings and the gas which is always evolving from these compounds is hydrocyanic acid gas, a deadly poison.

Ratproofing, broadly considered, is any method of construction designed to prevent rats from entering buildings or ships, or to prevent rats from finding nesting and hiding places. Ships with efficient rat guards on all lines attached to shore sometimes destroy their good work by allowing cargo nets and other gear to remain in contact with the shore at night when rats are active. Gangways should be lighted and the gangway watch alert to keep rats from climbing aboard whenever ships are berthed at piers or docks. Cargo, particularly food materials, should be stowed to permit easy inspection and provide the minimum hiding place for rats.

Rodenticides commonly used are warfarin, red squill, zinc phosphide, "Antu" (alphanaphthylthiourea), sodium monofluoracetate (1080), and strychnine. Red squill is least dangerous to human beings and domestic animals. It acts as an emetic and rats cannot vomit. It is necessary for rats to ingest a relatively large amount of red squill for effective results. Rats will often learn to avoid poison baits, and frequent change of bait material may be necessary.

Warfarin will not give effective control when applied in a single dose. It must be ingested several times (usually five or more) on successive days. The feedings need not be consecutive, but they should occur within a 10-day interval with no period longer than 48 hours between feedings. Because baits may not be accepted when first exposed, from 5 to 14 days may elapse before satisfactory control is attained. Usually, however, a marked reduction in bait consumption and damage occurs after the third day of treatment. Due to this slow action rats apparently do not associate the death of their companions with their food and an aversion to the baits does not develop.

There appears to be a minimum danger to other animals in the concentration used and recommended (0.025 percent), and potential hazard may be further reduced by using grain or cereal-type baits, which are unattractive to most flesh-eating animals. It is recommended, in the presence of other animals, that warfarin baits be exposed only in protected bait stations or other covered devices which will permit feeding by rodents but prevent access by larger animals. No accidents to humans have been reported. However, baits should not be exposed in locations accessible to children or irresponsible persons. In case of accidental ingestion, vomiting should be induced at once and a physician called. Treatment should include whole-blood (transfusions) and intravenous and oral administration of vitamin-K preparations as in the case of hemorrhages from dicumarol.

Warfarin is available under Standard Stock No. G–51–R–359–10 as a five-tenths percent concentrate. One pound of the preparation should be mixed with 19 pounds of bait to provide the recommended concentration of 0.025 percent. Cereal-type baits such as ground whole yellow corn meal or a mixture of equal parts of the yellow corn meal and rolled oats have given good results. Zinc phosphide is highly toxic to man, domestic animals, and to rats and must be handled with caution. "Antu" is of particular value against brown rats. It is used at a concentration of 1 percent by weight. Sodium monofluoracetate (1080) is an extremely potent rodenticide and must be handled only by qualified rodent-control officers trained in its use. See BuMed Instruction 6250.1.

All of these poisons may be mixed with baits and set out for rat consumption in carefully selected places. It is advisable to prebait with unpoisoned material for several days prior to poisoning to determine:

a. The type of bait most readily accepted by rats.

b. The places where rats come to eat the bait.

c. An estimate of the number of rats.

A careful count of the number of bait pellets distributed and eaten must be made. Careful control of poison materials must be maintained at

all times to avoid accidental poisoning of children, natives, and domestic animals. Poison baits commonly used include hamburger, fish, cereals, and coconut.

In all rodent control work familiarity with the habits of the rodents is the key to success. The tastes and the requirements of life for rats are similar to those of human beings. A thorough study of these requirements before deciding on a plan of attack will materially assist in the fight against them.

First-aid-procedures—poisoning by rodenticides

1. Call a medical officer. In the meantime:
2. Induce vomiting;
3. Keep the patient warm and quiet;
4. Administer intravenous fluids.

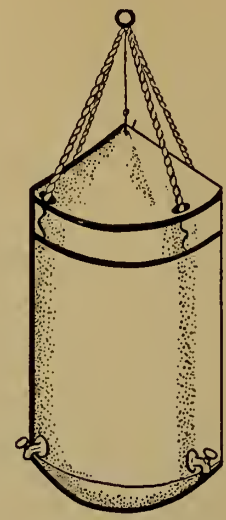

Figure 369.—The Lyster Bag.

Hygiene and Sanitation Under Field Conditions

The activities of a medico-military organization tend to concentrate toward one primary objective, *the conservation of physical efficiency for combat.* The hospital corpsmen of the Navy serve ashore as well as afloat, and in addition to their duties pertaining to naval warfare they must be prepared to serve as members of the medical department of a naval landing party or a Marine Corps expeditionary force; as such they must have a knowledge of field conditions. One of the prime requisites for victory is health; consequently, field hygiene and sanitation is of great importance to military personnel.

Safe Water

Water-disinfecting bag (Lyster bag).—The water-disinfecting bag, made of heavy canvas or rubberized cloth with a capacity of 36 gallons, is used primarily for the distribution of water previously disinfected by a water-purification unit or otherwise. Water is purified in a Lyster bag by means of chemicals; and owing to the difficulty of disinfecting small quantities of water having varying organic content, it is used only when no other facilities for obtaining purified water are available. Where emergency requires that the Lyster bag be used for this purpose, the disinfection should be under the direct supervision of medical department personnel. Ordinarily, however, as the disinfection of the water is a function of the company concerned, the actual work of chlorination is delegated to the personnel of the company kitchen. Without adequate supervision the water may be under treated and therefore not properly disinfected, or it may be overchlorinated to a degree which renders it nonpotable.

Technique for Disinfecting Water

The water should be as clear as possible. Clarification may be aided by allowing the water to settle in a barrel or galvanized can and then decanting or straining. The steps then used are as follows:

1. Fill the Lyster bag to the 36-gallon mark, or if this mark is not present, to within 4 inches of the top.

2. Draw a small quantity of water through one of the faucets into a canteen cup.

3. Break an ampule of the calcium hypochlorite into the water in the cup, and with a clean stick rub into a thin paste containing no visible lumps. Then add sufficient water to fill the cup two-thirds full.

4. Empty the solution of calcium hypochlorite in the cup into the water in the bag and stir thoroughly. Then flush out each of the faucets.

5. After the calcium hypochlorite has been in contact with the water in the bag for at least 10

minutes, wash out the faucets by allowing a small amount of water to run through it onto the ground. Then fill a clean cup about two-thirds full of water from one of the faucets.

6. Add 1 cubic centimeter (approximately 15 drops) of the orthotolidine solution to the water in the cup and allow it to stand for about 5 minutes so that the color will develop. Because of the reflected light the color of the water in the cup is more intense than it would be if the same water were placed in a glass tube. A marked yellow color indicates that the water contains about the proper amount of residual chlorine. An orange color is evidence of overchlorination.

7. If no residual chlorine is present at the end of the 10-minute contact period, the chlorination procedure as outlined above is repeated. Where it is suspected that the calcium hypochlorite is inert, a preliminary test with orthotolidine should be made immediately after the addition of the calcium hypochlorite solution to determine if the water contains any free chlorine at that time.

8. As a factor of safety the water should be allowed to stand for 20 minutes after the end of the contact period, or for 30 minutes after the addition of the calcium hypochlorite, before being used for drinking purposes.

9. The calcium hypochlorite now furnished contains about 70 percent available chlorine. This is the equivalent of $2\frac{5}{10}$ parts per million free chlorine when added in ampule form to a bagful of water. The organic matter in most water supplies in the field will utilize a great deal of this free chlorine so that the residual chlorine will be reduced to five-tenths to two parts per million. If there is little or no organic matter present, only a fractional part of the tube of hypochlorite should be used. When there is any doubt as to the purity of water furnished a unit, it should be chlorinated.

Other Emergency Measures

1. If water-disinfecting bags are not available, the water may be disinfected in the unit water cans, clean galvanized-iron cans, pails, or barrels. A proportional amount of calcium hypochlorite is used and the method of chlorination is the same as with the water-disinfecting bag.

2. If larger containers are not available, canteens may be utilized. One-half gram of grade A calcium hypochlorite is dissolved in a canteen of water. This strong solution is then used to purify water in other canteens. The cap of a canteen is used as a measure, and one canteen capful of the strong solution is added to each canteenful of water to be treated. The water should be well shaken and not used until 30 minutes after chlorination.

3. Iodine may be employed as a disinfectant instead of chlorine. Ten cubic centimeters of 7 percent tincture of iodine is used to disinfect a 36 gallon water bag. Two or three drops are used to disinfect a canteenful of water. The water should not be used until 30 minutes after the iodine has been added. Iodine tablets are now the standard canteen size water disinfectant. Use as directed on the bottle.

4. If calcium hypochlorite or iodine is not available, water may be purified by boiling for 10 minutes. Where practical the water should be boiled under supervision in comparatively large quantities and then distributed to the troops. Water may be boiled in galvanized-iron cans if they are available. Aeration of the water by pouring it through the air from one receptacle into another will eliminate the flat taste due to boiling.

Clean Mess Gear

After meals all mess gear should be sanitized in boiling water. In a semi-permanent camp the mess gear may be placed in wire racks and washed by immersion for 2 minutes in water that is kept boiling. On the march and under conditions where the mess kits are used, the following method of washing the individual mess gear is employed: Immediately after eating, personnel should form

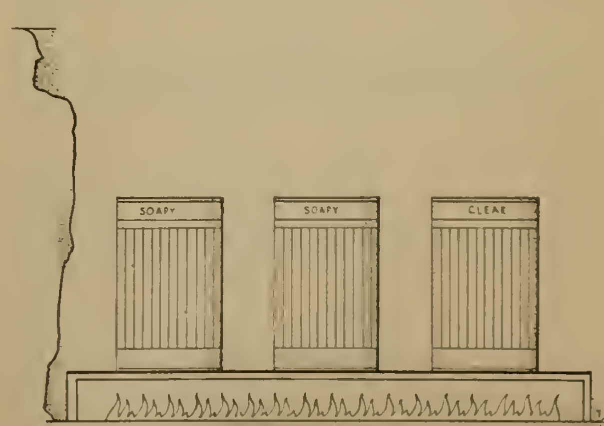

Figure 370.—Mess Gear Cleaning.

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a line and pass a garbage can or pit where the refuse and liquid and solid foods are disposed of. After disposing of this refuse, each man inserts his mess gear successively in three cans. These cans are placed over a trench in which a fire is burning. The first and second cans contain boiling soapy water, while the third can contains boiling clear water. A few moments' insertion in each of these cans is usually sufficient to cleanse and sanitize the utensils. After insertion in the third can, the mess gear dries by its own heat almost immediately and no wiping is necessary. Care should be taken to see that the water in each can is kept at a boiling point, as lukewarm dishwater is a potent factor in the dissemination of saliva-borne diseases.

Waste Disposal

In many semi-permanent camps or cantonments human feces may be disposed of by a water-carriage system. Should this system discharge into a municipal collection system, the disposal is simplified. More often, however, a sewage-disposal plant by other methods has to be considered. No matter what type of installation is used there should be sufficient latrine seat spaces to accommodate from 5 to 10 percent of the command at one time. In temporary latrines this requires 2 lineal feet per space. Usually 8 percent of the command are provided for.

During brief halts on the march the men who desire to relieve themselves should fall out, dig a hole with the entrenching tool, piece of stick, or some similar material; and after depositing feces, they should cover it well with earth. A trench may be dug for use during a halt for a meal.

In camps of short duration (1 to 5 days) trench latrines are provided. This consists of a trench not more than 1 foot wide and from 18 to 24 inches deep. Earth from the trench is piled at one end and the trenches should be constructed so as to provide 2 feet per man for about 8 percent of the command. No seats are provided; the man straddles the trench and squats over it. Each man covers his deposit with earth from the pile at the end of the trench. Toilet paper rolls may be placed on tent pegs near trenches if the weather is dry; otherwise, toilet paper should be kept dry in a box turned on its side. When the troops depart, the trench is filled in after spraying contents well with crude oil; and if there is a possibility of other troops occupying the site, it should be marked.

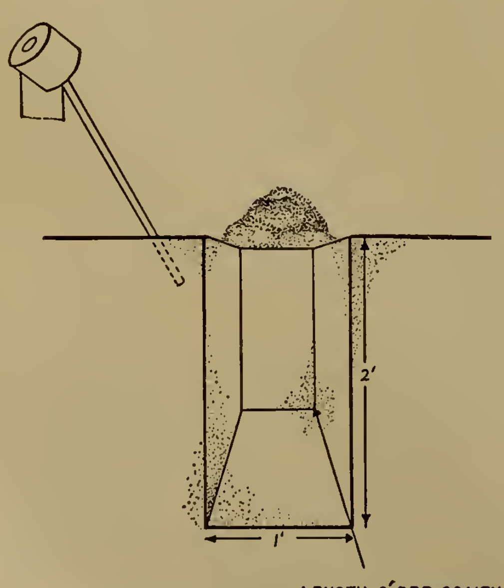


Figure 371.—The Trench Latrine.

Urinals

When the latrine is installed, a trough urinal should be built near enough so that it may be enclosed in the same enclosure. Ordinarily this trough may be V-shaped and lined with tar paper or galvanized iron. This trough is then connected with the latrine pit by means of ordinary galvanized drain pipe. The trough should slant toward the end in which the drain is located, and the drain hole should be protected by a wire mesh insert in order that it be not blocked by extraneous material thrown into the trough. The trough may be connected to a urine-soakage pit which is built outside of the enclosure if it is not desired to have the urine flow into the latrine pit (fig. 372).

Protection

Latrine and urine troughs should be enclosed with a latrine screen made of canvas or an improvised screen made of wood, brush, etc. Latrines should, wherever possible, be protected from rain by use of tents or tent flies. The entire enclosure should be ditched all around so that rain and drainage water will be carried away.

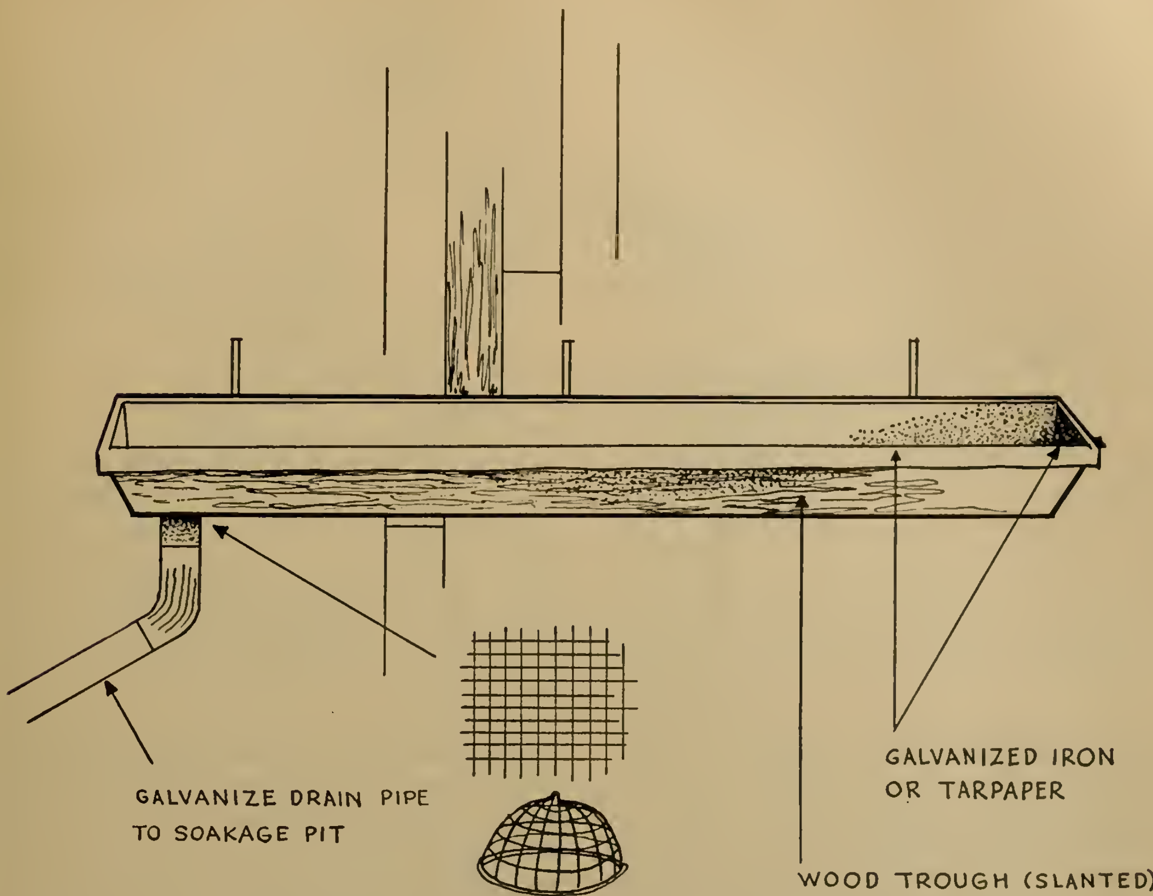


Figure 372.—Urinal.

Bored-hole Latrine

This type of latrine has been used extensively in the Far East. It consists of a round hole 14 to 18 inches in diameter and 15 to 20 feet deep, made with a posthole auger. The box may be single seat or a concrete slab with a hole similar to the box seat in Fig. 373.

Urine-soakage Pit

A hole 4 feet square is dug and filled with broken stone 1 to 4 inches in diameter. (Flattened cans, broken bottles, bricks, etc., may be substituted.) A square ventilating shaft 4 to 6 inches in diameter minimizes odor production. The shaft should extend from about 1 foot above the surface to within 6 inches of the bottom and should contain a number of holes. The top of the shaft should be covered with fine screening to prevent ingress of flies. The pit may be surmounted by a square trough urinal, or it may have a one-half inch to 2-inch pipe placed in each corner at an angle of 30° to the vertical plane and extending about 1 foot into the pit. A metal or tar-paper funnel is placed in each pipe to receive the urine. In loose soil one soakage pit will dispose of urine from 100 men for an indefinite period (fig. 374).

Location of Latrines

Latrines should be at least 100 yards away from company kitchens and at least 100 feet from any well or spring.

Care of Latrines

Latrines should be policed daily and should be lighted at night. If flies are prevalent, routine fly control measures should be enforced. The outside of the box should be scrubbed daily with soap

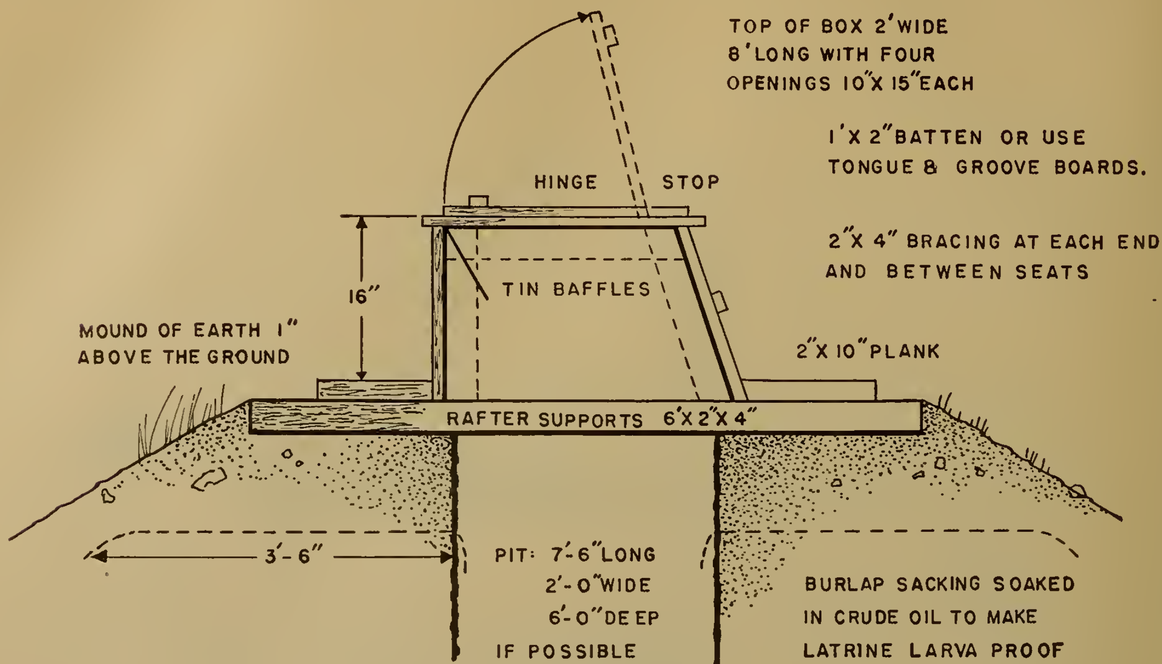


Figure 373.—Latrine with Box Seat.

and water and the seats twice weekly with 2 percent cresol solution. Urine troughs should be scrubbed daily with soap and water. Crude oil should not be used in urine trough if trough is lined with tar paper or drains into a urine soakage pit. A brush for latrine seats and urine trough may be made by fastening a handle to one-half of an ordinary scrubbing brush.

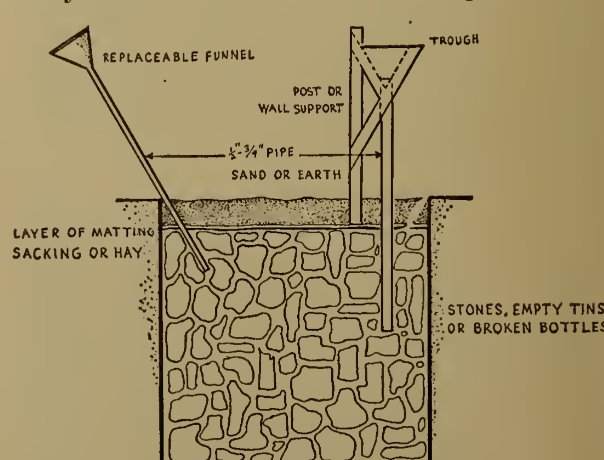
Pail Latrines

The pail latrine is usually installed where buildings without adequate plumbing facilities are used as barracks or hospital wards. A standard latrine box may be adapted for use as a pail latrine. When it is located in a building, the latrine should be built in so that the pails can be removed from the rear and from the outside of the building through openings in the wall. These openings should be fitted with hinged doors. The pails should be removed at least once daily and replaced by a clean pail immediately. The bottom of the pail should contain about 1 inch of a 2 percent cresol solution. Pails of excreta from pail latrines may be removed by hand, cart, truck, or wagon and disposed of in one of the following ways:

1. By burial.
2. By dumping into manhole of community sewer if one is available and sewage-disposal plant will handle additional load.
3. By incineration.
4. By placing in flyproof concrete tanks where it undergoes decomposition.

Liquid Kitchen Wastes

In camps where sewers are available, liquid wastes may be disposed of by dumping them directly into sewer lines. In most camps, however,



(MODIFIED FROM LOLEAN)

Figure 374.—Urine Soakage Pit.

this is impossible and some arrangement must be made to dispose of these liquids in the soil. In order to facilitate absorption and to prevent clogging of the soil, liquid kitchen wastes should have the grease removed before they are discharged into any kind of pit or trench. A bed of absorbent natural materials through which wastes may be run will serve as an effective trap.

Industrial Health Problems

The Medical Department has responsibility for the operation of the Industrial Health Program throughout the Navy. The medical officer in establishments other than those under management control of BuMed is responsible to the Commanding Officer for the operation of the Industrial Health Program for civilian and military personnel. This includes not only medical care of occupational diseases and injuries, but also the industrial hygiene engineering program. It is possible that a hospital corpsman on duty at an industrial establishment, such as a shipyard, air station, or aboard ship, may be assigned to assist the industrial hygiene officer or the medical officer in conducting industrial hygiene surveys.

Industrial hygiene deals with the hazards involved in carrying on industrial work and, generally speaking, cover occupational diseases which are contracted slowly over long periods of time. Industrial hygiene has been defined as the prevention of occupational disease and the promotion of individual efficiency through improved working conditions. Industrial hygiene, more specifically, may be defined as the detection, evaluation, and control of chemical, physical, and biological agents of the work environment capable of causing disease or—being conducive to discomfort—lowering the level of worker productivity. Not only does industrial hygiene concern itself with occupational disease which may arise from inhalation, skin contact, or ingestion of toxic substances; but also with discomfort and inefficiency as a result of working in unduly humid, hot, or cold atmospheres, confined spaces, and uncomfortable positions, excessive vibrations, pressures, noise, and poor lighting.

Chemical agents that may cause disease are dusts, fumes, gases, mists, and vapors. Physical agents that are potentially harmful to health and efficiency are actinic rays (ultraviolet and infrared) from welding, excessive noise, poor lighting, and ionizing radiation.

Military personnel are exposed to many of the same hazards to which civilians are exposed in their daily work. This is demonstrated not only where we find servicemen and civilians working side by side as in numerous governmental industrial activities but also aboard ship. For all practical purposes each ship afloat can be considered as a small industrial plant, and many, such as tenders, battleships, and carriers, are equivalent to some of our large plants, carrying on such varied industrial operations as foundry work, forging, painting, degaussing, machining, welding, plating, casehardening, and a host of other commonplace industrial operations in order to function routinely.

When carbon tetrachloride or other chlorinated hydrocarbons are being used as solvents or degreasers, three principles should be observed:

1. Never use the chemical without adequate ventilation.
2. Do not allow it to come in contact with the skin.
3. Use a less toxic substitute if a suitable one can be found.

Operations carried out by service personnel have associated with them specific hazards:

1. Gases and fumes generated by explosions or fire.
2. Damage or misuse of refrigeration machinery or firefighting equipment containing volatile chemicals.
3. Gases generated from internal-combustion engines.
4. Use of large quantities of high-octane gasoline containing tetraethyl lead, in which, in addition to the ordinary hazard of gasoline, there is the added risk of tetraethyl lead poisoning from the cleaning of storage tanks.
5. Cleaning aircraft spark plugs by sandblasting.
6. Scraping and wire brushing the bottoms of ships, etc.
7. Salvage operations and the gases associated with bacterial decomposition in closed spaces.
8. More recently the handling of the numerous fuels and chemicals employed in the operation of guided missiles.

9. Painting, with exposure to vapors of thinners and other potentially harmful ingredients.

The basic industrial hygiene engineering control measures to protect the worker from harmful agents can be outlined as:

1. Ventilation (removal of the contaminant at the point of origin by local exhaust or dilution by general ventilation or supplied air).
2. Isolation of hazardous processes.
3. Substitution of less toxic agents (when feasible).
4. The use of personal protective devices such as respirators, protective clothing, welder's helmets, etc.
5. Personal cleanliness.
6. Housekeeping.
7. Combination of one or more of the preceding measures.

General awareness of these problems, which are potentially hazardous, can save many lives in emergencies and can also, if steps are taken in time, avert tragedies entirely. In spite of repeated warnings which may be issued from time to time concerning the dangers enumerated above, deaths and sick absenteeism are constantly occurring from them among service personnel.

The introduction of new materials and processes continually into naval usage points to the desirability of obtaining industrial hygienist opinion wherever possible at the earliest practicable stage so that when the existence of a hazard is known or suspected, the means of prevention and the necessary steps and safeguards can be decided.

One of the hazards to which naval personnel often expose themselves unnecessarily is entering a closed space to work without testing for oxygen deficiency or poison gas content. Death may result within a short time of entering due to anoxia or the presence of noxious gases. **The following precautions should be observed:**

1. Never enter a closed compartment, double bottom, or any space that has been closed for some time until the oxygen content within has been measured. Tests should also be made with an Explosiometer for explosive gases. If there is reason to suspect their presence tests may also be made for carbon monoxide, hydrogen sufide, Haldane gas, hydrogen cyanide, or other gases that might conceivably be present.
2. When men are working in a closed compartment, helpers with oxygen equipment should be continuously stationed immediately outside. Rescue breathing apparatus and first aid equipment should be immediately available.

In ventilating a closed compartment the type of operation being carried on inside should determine the method of ventilation to be used. If dust-producing operations such as chipping, grinding, or sanding are being performed, air should be sucked out of the compartment. If the operations are non-dust-producing, air can be blown into the compartment.

Safety

At activities under the management control of the Bureau of Medicine and Surgery, the operation of the accident prevention program is the responsibility of the Medical Department. In activities under the management control of other Bureaus or aboard ship, the responsibility may be assigned the Medical Department if the commanding officer so wills. The general practice is to assign accident prevention to a line officer or in industrial establishments to the Industrial Relations Division.

However, the Medical Department ashore and afloat is regarded as an authoritative source of information and advice on prevention of accidents, as well as prevention of industrial disease, and it behooves all Medical Department personnel to keep abreast of developments in accident prevention. At hospitals and other commands under the management control of the Bureau of Medicine and Surgery, the Medical Department is of course responsible for the operation of the command's accident prevention program. This section will be limited to a discussion of some of the most important occupational hazards in hospitals. The preventive work is done through indoctrination, inspections, reports, and recommendations. Overall responsibility for safety, however, rests with the command, and it is the duty of the executive officer to make necessary arrangements for safety and to see that they are enforced.

The cooperation of all hands is essential in carrying out a safety program, which has three aspects—engineering, education, and enforcement.

1. **Engineering.**—The combination of all those physical and material measures applicable to ma-

chines, material, and equipment, and processes and assemblies, leading to safe operation and performance. Here the Safety Officer functions by:

Inspecting areas, equipment, materials, and supplies to determine that all possible safety practices and procedures are applied and reporting any lack of such practices.

Investigating and analyzing the causes of all accidents.

Recommending any changes or additional measures deemed necessary to prevent a new type of accident or recurrences of old ones, based on inspections and investigations.

Engineering also includes:

Correcting unsafe conditions and practices.

Providing personal protective equipment (hard hats, safety shoes, hardened-lens safety glasses, respiratory equipment, safe tools properly cared for) and machine safeguards.

2. **Education.**—Training and indoctrination in all measures for the safe operation of machines and equipment. This involves:

Knowing all safety rules.

Providing time for training and periods of discussion.

Instructing personnel in safety rules and safe practices.

Promoting proper attitudes in personnel for their own safety and that of others.

3. **Enforcement.**—The tool which insures the carrying out of rules and regulations until such time as engineering and education have become so effective that the use of force is no longer necessary. Since human frailty will probably delay this desired end for some time to come, it is necessary to:

Enforce all safety regulations and rules.

See that personal protective equipment and machine safeguards are used and machines properly maintained.

Carry out recommendations for changes based upon inspections and investigations of accidents.

Areas of Special Hazards

Hospitals, infirmaries, dispensaries, and ships may have general hazards requiring ordinary home, industrial, and fire safety practices. In addition there are special hazards peculiar to hospitals, such as those arising in operating rooms and in radiological work. Handling the mentally ill requires special care, as does the use of acids, medicinal gases, electrical machines, units, and appliances. Hospital personnel must be alert for fire and well trained in the evacuation of patients in the event of fire. Safety precautions for some of these special hazards, or sources of information on them, are presented below.

Hospital Operating Rooms

Information on safe practices in the use of combustible, anesthetic gases may be obtained from a pamphlet (N. F. P. A. No. 56) published under the guidance of the National Fire Protection Association, Sixty Batterymarch Street, Boston 10, Mass.

The use of combustible anesthetic agents such as cyclopropane, divinyl ether, ethyl chloride, ethyl ether, or ethylene is usually accompanied by considerable risk, in areas not especially designed for their use, because they form flammable mixtures when combined with air, oxygen, or nitrous oxide, the form in which these gases are generally used. When combined with oxygen, or the air, they are violently explosive if exposed to an ignition source. These principal sources of ignition are: electrical equipment (in operation of which an arc or spark may occur of sufficient magnitude to explode the gas); static electrical spark (which is that form of electricity that occurs on any charged body in certain humidities, or by the "charging" of persons, equipment, or supplies by the separation of dissimilar materials such as wool, some fibres, and plastic textiles like rayon or nylon); open flames, sparks or arcs, or glowing elements (such as heat from an electrical hotplate, lighted pipe, cigar or cigarette; open light or heat element such as blanket-warmer); and, of course, spontaneous ignition, by accidental use of oxidizing material such as oil or grease on reducing valves or gas cylinder gages. Flames or hot materials at temperatures of about 180° C. (356° F.) cannot be used with safety in the presence of anesthetic gases.

The most careful use of these agents is therefore required so that fires or explosions do not result. The most important elements of danger are the ignition sources and these may be obviated by:

1. *Grounding all personnel and equipment to a common ground* (*the floor*).—If the flooring is

conductive (having the ability to transmit an electrical charge to a known ground), all personnel and equipment on the floor and connected to it by conductive shoes or other personal bonding device will have the same static potential and thereby be incapable of transferring an electrical charge to another body of sufficient magnitude to cause a spark.

2. Making sure that *electrical equipment* is wired and safeguarded by special outlets, wall receptacles, and plugs to prevent withdrawal of the electrical wire from connection to the equipment while under load.

3. *Isolating the electric circuit* in the operating suite from other electrical source and inclusion of an ungrounded circuit.

4. *Having a warning-alarm device* within the circuit. This is required to prevent the accidental "shocking" to the personnel who are on the "conductive floor" from an uninsulated electrical appliance or from the introduction into this circuit of a wire that is not properly insulated.

The general requirements for electrical wiring and equipment will be found in the National Electric Code, Article 500, for installations in class I, group C, Division 1, installations.

Because of the density of the gases used as anesthetic agents, they tend to settle to the floor surface, as gaseous vapors tend to flow to the lower surfaces. The general area in a hospital operating room may be defined as "on a 5-foot level." This means that, generally speaking, the area above this 5-foot level is not hazardous. All of the area below the 5-foot level is hazardous, and no electrical equipment of any kind that is not explosion-proof should ever be used. Any electrical equipment intended for use in the hospital operating room should be of such type as will not arc or spark in use.

The equipment used in surgical operating rooms may be any of the following: Control devices for electrical equipment, receptacles and attachment plugs, lighting switches, X-ray film viewing boxes, signaling systems, portable electrical equipment, flexible cords, suction and pressure equipment, X-ray equipment, high-frequency equipment, low-voltage equipment, and instruments, and cautery equipment—all of which must be separately considered before use in the presence of explosive gases.

Transferring the contents of one large cylinder to another cylinder of any size is prohibited, and the use of any gas from cylinders and pipelines has certain hazards. Therefore safe practice requires that special training be given before any person is permitted to perform tasks relating to the use of oxygen or any other gas.

Authorities are in agreement that safety in handling compressed medical gases can be realized only when personnel:

1. Have been indoctrinated and trained in the safe handling of medical gases.

2. Have become familiar with the chemical properties and characteristics of the individual gases which make mandatory the employment of safe practices and the following of safety rules.

3. Have developed an attitude of conscientiousness toward safety at all times when handling cylinders and administering gases as directed by the medical officer.

Hazards vary greatly in the different medical gases, but they may be generally grouped for classification as:

1. Nonflammable gases which support combustion—oxygen and nitrous oxide.

2. Flammable gases—cyclopropane, ethylene (nongaseous but flammable—divinyl ether—ethyl chloride—and ethyl ether).

3. Nonflammable inert gases—helium, carbon dioxide, and nitrogen. Carbon dioxide is toxic in high concentrations; helium or nitrogen will cause asphyxiation in pure or gaseous forms or in high concentrations by displacing oxygen in closed or close compartments or areas.

In order for any material to burn, three things are necessary:

1. The flammable material.

2. The ignition source or high temperature.

3. Oxygen.

When any gas is compressed rapidly its temperature is increased. When a regulatory or reducing valve is attached to an oxygen cylinder and the regulator or valve is opened rapidly, the gas in the regulator or valve is rapidly compressed and therefore rapidly heated (ignition source). If flammable material is present, fire will result.

This flammable (oxidizing) material may be oil, grease, dust, lint, or soap (fat). Oxygen cylinders must be clean, free from oil, grease, dust, lint, or soap; and the regulator, reducing valve, and cylinder valve must always be cracked or opened slowly.

Medical personnel must be specially trained in the maintenance of medical equipment before anyone is permitted to make repairs to any such equipment especially cylinders, valves, or equipment using medical gases under pressure. Maintenance contracts are maintained with suppliers of medical equipment and gases, and it is not necessary for untrained personnel to risk injury to themselves or others to repair this specialized equipment used in conjunction with compressed gases.

Nationally accepted regulations require that compressed gas cylinders meet special standards and that when they are shipped they comply with certain specifications. The filling of cylinders is also regulated, as is coloring of the cylinders, and the standards of the United States Pharmacopeoia regulate the purity of the gases. Labels of a specific size, shape, and color further safeguard the supply.

The following are briefly the safety precautions for use of all cylinders, and it should be remembered that they are distinct from operating practices or procedures:

General Rules for Use of Cylinders

Keep cylinders clean and free of oil, grease, dirt, lint, dust, or soap.

Do not lubricate valves, cylinders, reducers, or regulators.

Do not let anyone handle these cylinders with oily or greasy hands or gloves.

Connections should be tight to prevent leakage and should never be made in line or equipment while line is under pressure.

Never attempt to locate leak with open flame or soap suds. Disconnect lines, turn off gas at cylinder head, and make all connections over again.

Do not permit smoking or any uncovered lights, open flames, glowing element, or ignition source of any nature close to gases under pressure.

Do not interchange regulators, reducers, valves, or appliances from one gas to another on equipment intended for use with a specific gas.

Open cylinder valve slowly and fully when cylinder is placed in use.

Never attempt to mix gases in cylinders or make line connections of dissimilar gases.

Do not cover cylinders with paper, wrappings, or cloth covers, and remove any paper wrappings or covers before placing any cylinder in use. Be sure that label identifying the gas is visible.

Temperatures affect gas pressures. Do not expose cylinders to any heat source such as radiators, steam pipes, furnace rooms, or direct sunlight. The upper limit for temperature is about 120° F.

Do not transport or move cylinders unless the valve bonnet is in place and secure. Do not return empties without bonnet caps.

Do not use oxygen for nebulization of oily medicinal substances, use only hand nebulizers. The hazard of nearness or exposure to oil is too risky to involve the use of oxygen; use compressed-air cylinders if this is required.

Cylinders should always be transported in dolly wheels or on suitable trucks or cylinder-carrying devices, and the cylinder should be strapped or chained to a solid support at all times.

Do not store oxygen or oxidizing agent near explosive anesthetic gases, and do not store oxygen in same storage area with the explosive anesthetic gases.

Cylinders in storage—either full or empty—should be under lock and key to prevent any handling by unauthorized personnel.

No cylinder should be completely exhausted of its contents. This causes cylinders to become contaminated and wet, and when used in connection with other gases, they may be drawn back in a completely emptied cylinder.

All of the information necessary for safe precautions in respect to nonflammable medical gas systems may be obtained from pamphlet No. 565 of the National Fire Protection Association.

Precautions in Use of Oxygen Tents

The constant danger that some ignition source may come in contact with bedclothes, cabinets, or the oxygen tent itself indicates the necessity for the strict enforcement and observation of the "No Smoking—Oxygen in Use" signs that are posted whenever oxygen therapy is being administered. Oxygen is not a flammable gas but it supports combustion, and in an oxygen-enriched atmosphere

materials that are otherwise slow in combustion become violently flammable. This does not happen often, but there is a chance it will occur and for this reason alone, matches, lighters, cigarettes, cigars, pipes, or smoking materials of any kind should be removed from all patients under oxygen therapy.

The tents must be kept clean and free of oils, grease, soap, lint, and dust. The compression radiator of tents should be examined for lint and dust and periodically cleaned. The chief hazard is exhaustion of oxygen supply, which exhaustion could be fatal to the patient. Furthermore accumulation of carbon dioxide will build up to dangerous proportions in only a few minutes.

The drying effect of pure oxygen is overcome by the use of humidifiers. Each humidifier should be equipped with a safety relief valve to prevent its building up excessive pressure accidentally and shattering. Humidifiers should be equipped with a baffle-valve to prevent overflowing of the jar if filled to excess; great care should be exercised to keep the jar from overflowing.

In using disinfecting or sterilizing solutions on oxygen-therapy equipment when cleaning after use, one should take care that these often irritating solutions are not left as deposits in folds of material or in tubes or breathing bags.

Quick-coupling devices should be used when available so that connections, if broken, will automatically shut off the flow of oxygen in case of line breakage or other untoward event.

Safety in Use of Sterilizers

The manufacturer's operating instructions should be read by and to all persons prior to their indoctrination in the use of any sterilizer. No matter how old a sterilizer is, instructions and operating procedures are available without cost from any manufacturer supplying sterilizer equipment to the Navy Department.

Sterilizers and their contents can become contaminated by a back-pressure or by using polluted water. Leakage of drain valves or wrong cross connections have caused contamination of otherwise sterile materials. Vent lines must be installed so that it is impossible for the condensate to drip back through vent pipes into sterilizers. To prevent cross connections which might result in contamination of sterilized materials, new plumbing installations should be sanitary and existing installations checked periodically.

The pressure-type sterilizers are engineered to withstand pressures in excess of those normally employed. They are all equipped with pressure-relief valves, and these require daily checking when in use and occasional lifting to ascertain their working condition.

On gas-heated sterilizers, thermopilot installation is required to provide automatic safety control which will shut off the gas if the pilot light goes out or fire fails in combustion chamber. These types of sterilizers should not be used close to the operating room suite or central supply room, but they should be located at a remote distance from the surgery. These require proper ventilation.

Electrically heated sterilizers require adequate fuse protection and separate electrical switches. They must have low-water power cutouts, and these devices should be checked by competent electricians.

The equipment must be properly cared for to function properly. Graphite must occasionally be used on door seals and gaskets to prevent sticking. All doors should be guarded by a device that prevents opening the chamber while steam is present under pressure.

Each pressure sterilizer and autoclave should be inspected at regular intervals (dependent upon rate of use) by personnel qualified for such work. Tests for air and steam clearances are most important in some types of pressure sterilizers. Air clearances are highly important for the safe operation of steam sterilizers. Gages attached to sterilizing chambers indicate pressures, and thermometers in the chambers should indicate temperatures to correspond with steam pressures. If these do not validly correspond, it is usually indicative of air in the chamber.

Radiological Safety

Safe practices in the use of radiological isotopes are dealt with in a manual published by the Bureau of Medicine and Surgery on that subject and will not be covered in this chapter.

To protect personnel whose duties require the handling of radioactive materials, special training is required before any use of these materials is permitted. Protective clothing is required, and this

consists of hard hat or protective head covering, safety glasses, provision of washable or disposable outer garments, appropriate footwear protected by booties or disposable coverings, gloves, respirators if required, and the indicated photodosimetry instruments or equipment. All of the exposed materials worn as protective equipment must be monitored before issue and must be taken care of by specially trained personnel after use.

The regulations which relate not only to exposure of personnel to radioactive areas or materials but also to time limits must be published. Local or station radiological safety committees (appointed by the commanding officer) of each activity engaged in the use of radioactive materials shall formulate safety rules applicable to the mission.

In brief, the success of a safety program designed for the protection of personnel, material, and equipment requires that personnel:

1. Know, understand, and obey all rules and regulations designed for all mechanical or industrial procedures.

2. Wear the prescribed protective clothing or equipment designed for the task or operation.

3. Use only those safe tools, machinery and equipment with which he is familiar and is authorized to use or operate.

4. Work with regard for his own safety and that of personnel working with him.

5. Advise immediate superior of unsafe conditions, tools, or tasks, and help instruct others in safe working practices.

6. Maintain clean shops, tools, working spaces or areas and insist that others do likewise.

7. Refrain from skylarking or creating any distractions of others at work: think, live, and act safely, that the mission or the task may be completed with dispatch and good workmanship.

Chapter VII

MATERIA MEDICA AND PHARMACOLOGY

INTRODUCTION TO MATERIA MEDICA

Materia Medica is the study of drugs and dosage and their body actions.

Pharmacy is the science of preparing and dispensing medicines.

Dosage is the study of the amount of drug which is required to produce the desired therapeutic effect. Doses are classified as:

Average dose, or customary dose, as it appears in the U. S. P. or N. F. This is an average effective dose for a human adult.

Minimum dose, or the smallest amount of drug which will produce the desired effect.

Maximum dose, or the largest amount of drug which can be administered without producing toxic symptoms.

Toxic dose, or poisonous dose.

Minimum lethal dose (M. L. D.), the amount of drug just sufficient to cause death.

The dose of the drug depends upon the patient's body weight, age, sex, temperament, habits, idiosyncrasy, and occupation; the nature of the disease; the form of the drug; the method, frequency, and time of administration.

Drugs are given: orally, sublingually (under the tongue), by inhalation, by rectum, by inunction (ointment), intradermally, subcutaneously, intramuscularly (in the muscle), or intravenously (by vein).

Toxicology is the science of poisons.

A poison is a substance which, when taken into the body can produce death or serious injury.

There are two types of poisoning:

Acute.—Caused by a toxic or lethal dose or by the cumulative effects of smaller doses taken at frequent intervals.

Chronic.—Caused by small quantities of cumulative poison taken into the body over a long period.

Certain conditions modify the actions of a poison:

The physical state of the poison, whether gas, liquid, or solid.
The various channels of absorption.
The amount of poison taken.
Body weight and age.
Idiosyncrasy.
Habit.
Natural tolerance.
General health.
Time of administration.

The symptoms vary with the quantity of poison taken and absorbed and the length of time it remains in the body.

Diagnosis of poisoning is often difficult because the symptoms resemble those of certain diseases. Few poisons show symptoms sufficiently characteristic for positive identification. However, there are several aids to diagnosis:

Corrosive action produced.
Color of the stain it leaves.
Odor of the breath.
Condition of the gastrointestinal tract.
Respiration.
Pulse.
Body temperature.
Motor disturbances.
Condition of eyes, teeth, gums, and skin.
Cerebral effects.
Cardiac effects.
Color of the urine, condition of the feces and vomitus.

The treatment of poisoning involves the use of antidotes. Antidotes are any measures that will remove, prevent the absorption of, or counteract the systemic effects of a poison. They are of three classes:

Mechanical antidote.—One which removes the poison from the stomach or a surface of the body, i. e., emetics, gastric lavage, tickling the throat to cause vomiting.

Chemical antidote.—One which chemically neutralizes the poison.

Physiological antidote.—One which counteracts the systemic effects of the poison. This type is usually given hypodermically.

The treatment of poisoning is to:

1. Remove the poison.
2. Prevent its absorption.
3. Render the poison nontoxic; counteract the systemic effects; prevent death; and eliminate the absorbed poison from the body. Poisons may be classified as:

Local poisons.—Those which cause corrosion, blistering, burning or irritation.

Systemic poisons.—Such as drugs acting on the cardiovascular system, respiratory system, and nervous system.

In a case of poisoning, save all foods, medicines, vomitus, feces, urine, or any other item that may help in determining whether the poison was taken accidentally or intentionally or was criminally administered.

The drugs in this chapter will be discussed according to their therapeutic classification. Only a brief summary will be given, and the student is referred to the U. S. P., the N. F., or other standard books of reference on Materia Medica for a more complete study of each drug.

ACIDS

Acids are organic and inorganic. The strong acids are hydrochloric, sulfuric, nitric, nitrohydrochloric, and phosphoric. Weak acids are boric, hydriodic, hydrocyanic, and the organic acetic acids. The strong inorganic acids are mineral or corrosive acids.

The official concentrated acids are not of uniform strength, but the official diluted acids have a uniform strength of 10 percent, with the exception of diluted acetic acid and diluted nitrohydrochloric acid.

Action of acids.—Mineral acids have an astringent action. When used in concentrated solution, they have a caustic effect on the tissue and may cause the dead and coagulated tissue to drop off. This caustic effect is used to rid the skin of warts and moles.

The natural acid present in the stomach is hydrochloric. In patients having a deficiency of hydrochloric acid in the stomach, diluted hydrochloric acid is given with meals. When taken by mouth, mineral acids should be well diluted and taken through a glass tube to avoid injury to the teeth.

Toxicology.—The most corrosive of the mineral acids are sulfuric, nitric, and nitrohydrochloric. Hydrochloric and phosphoric acids are less corrosive, but they all rapidly destroy organic tissue. Detection of acid poisoning may be aided by the stains produced upon the body or clothing. Sulfuric acid removes water from tissue and blackens organic matter (carbonization). Nitric acid stains a deep yellow. Nitrohydrochloric acid produces a light yellow stain.

The general symptoms of poisoning by mineral acids are similar: intense pain in the mouth, esophagus, and stomach; severe vomiting (with sulfuric acid, the vomitus may be black or tarry); diarrhea; rapid weak pulse; shallow respiration; subnormal temperature; possible ensuing shock. Death from collapse may occur in a few hours. The mind is usually clear until the end nears, when there may also occur a suppression of urine and failure of voice.

Treatment

1. Immediately neutralize the acid with a nontoxic alkali such as milk of magnesia or magnesium oxide.
2. Do not give any alkali carbonates, as the carbon dioxide gas may blow up the stomach and damage stomach walls.
3. Do not give an emetic or put down a stomach tube as you may further damage the stomach walls.
4. Give soothing demulcents as starch, egg white, or milk.
5. The patient should then receive symptomatic treatment.

Hydrochloric Acid—Acidum Hydrochloricum, HCl (Muriatic Acid).—The official diluted acid is employed in the treatment of achlorhydria and hypochlorhydria.

Technical Hydrochloric Acid is the muriatic acid of commerce. It contains impurities such as ferric chloride and organic matter, which give it a yellow color. This form of hydrochloric acid must not be confused with the official acid.

Diluted Hydrochloric Acid.—10 percent HCl. Dose: 4 cc. (1 fluidrachm).

Glutamic Acid Hydrochloride.—Acid Glutomici Hydrochloridum.—The uses are those of hydrochloric acid in achlorhydria due to perni-

cions anemia or other causes and hypochlorhydria. Dose: 1 gm. (15 grains). Glutamic Acid Hydrochloride capsules. Dose: 1 gm. (15 grains).

Nitric Acid.—Acidum Nitricum, HNO_3. A fuming liquid, very caustic, having a characteristic, highly irritating odor, contains 67 to 71 percent cf HNO_3 rarely used internally. Nitric acid is highly escharotic and sometimes is employed for the removal of warts.

Nitrohydrochloric Acid.—Acidum Nitrohydrochloricum (Nitromuriatic Acid, Aqua Regia).—A yellow, fuming, very corrosive liquid, with a strong odor of chlorine; a concentrated aqueous solution containing HCl, HNO_3, nitrosyl chloride, and chlorine; prepared by mixing 20 parts of nitric acid with 80 parts of hydrochloric acid. It should always be prepared fresh.

It is used well diluted, in the treatment of hypochlorhydria. As a cholagogue it is used in the treatment of liver and bile duct disorders. Dose: 0.2 cc. (3 min.).

Diluted Nitrohydrochloric Acid.—Represents about 22 percent of the strong acid. Dose: 1 cc. (15 min.)

Sulfuric Acid.—Acidum Sulfuricum, H_2SO_4 (Oil of Vitriol).—A colorless, odorless liquid of oily consistence, very caustic and corrosive. Its uses are chiefly pharmaceutical and chemical.

Diluted Sulfuric Acid.—10 percent H_2SO_4.

It may be used instead of HCl in gastric hypoacidity; as an astringent, it is used in treatment of serous diarrhea.

Phosphoric Acid.—Acidum Phosphoricum, H_3PO_4. A colorless, odorless liquid of a syrupy consistence. Its uses are chiefly pharmaceutical and chemical.

Glacial Acetic Acid.—Acidum Aceticum Glaciale, $CH_3.COOH$. A clear, colorless liquid, with a pungent, characteristic odor and, when well diluted with water, an acid taste; miscible with water, alcohol, and glycerin; contains about 99 percent of $CH_3.COOH$.

Action.—Glacial Acetic Acid is very irritating to the skin, sometimes causing blistering, but it destroys only the most superficial layers. Sometimes it is used as an escharotic to remove warts and calluses. Taken internally, it produces some of the irritating effects of the corrosive acids. Diluted to 6 percent strength, it is similar to vinegar and when applied to the skin has a cooling effect and slight astringent action, checking excessive local perspiration. It is sometimes used as an antidote in caustic alkali poisoning.

Acetic Acid.—36 percent.

Diluted Acetic Acid.—6 percent. Dose: 2 cc. (30 min.).

Lactic Acid.—Acidum Lacticum, $CH_3CH(OH)COOH$. A clear, colorless, syrupy liquid. It is used as a spermatocide and in baby formulas.

Trichloracetic Acid.—Acidum trichloroaceticum, $Cl_3C.COOH$. Occurs as colorless crystals.

It is a strong caustic, used primarily in removal of warts, moles, and calluses, largely replacing glacial acetic acid for this purpose. An active germicide, it is occasionally used in the treatment of mouth infections such as Vincent's infection.

Chromium Trioxide.—Chromii anhydridum. (Chromic anhydride, chromic acid).

Caution.—Chromium trioxide should not be brought into contact with organic substances or other reducing agents.

ANTACIDS

Antacids are drugs used to counteract too much acid in the stomach or to correct a low alkalinity in the body fluids.

Action.—Normally there is a certain degree of acidity in the stomach. The stomach contents may become too highly acid, irritating the mucous membrane and causing symptoms commonly spoken of as indigestion or dyspepsia. Antacids such as sodium bicarbonate, magnesium oxide, magnesium carbonate, or milk of magnesia are indicated in this condition. The intestinal tract is normally slightly alkaline. As a result of disease it may become acid, usually causing diarrhea. Chalk is the drug of choice in the treatment of intestinal acidity.

OXIDES AND HYDROXIDES

Action.—These drugs neutralize acids and dissolve proteins, and in a lesser degree combine with fats while acids simply kill tissue, caustic alkalis actually dissolve it, producing an effect both quicker and deeper. Since caustic alkalis produce such local irritation, they are not generally used

as antacids. Certain insoluble oxides and hydroxides, such as those of calcium and magnesium, are frequently used to correct acidity in the stomach.

Toxicology of Caustic Alkalis.—Those which will be referred to are sodium and potassium hydroxide (lye).

Symptoms are pain in the throat and epigastrium, with nausea and vomiting. The vomitus may be dark brown, due to the presence of decomposed blood. The mucous membrane of the mouth is slippery and swollen, often brownish in color. In severe cases, shock may ensue. If the patient survives, a stricture of the esophagus, due to the local caustic action, may develop.

Treatment

1. Neutralize the alkali. Give diluted acetic acid, vinegar, two tablespoonfuls of vinegar in a half glass of water. Lemon juice may be used, or well-diluted mineral acids.
2. Olive oil or other fixed oils are effective as demulcents.
3. Do not use a stomach tube or emetic. After neutralization of the alkali, treat the patient symptomatically.

Sodium Hydroxide—Sodii Hydroxidum, $NaOH$ (caustic soda, soda lye, sodium hydrate).—White, or nearly white, fused masses, small pellets, flakes, sticks, and other forms; hard and brittle; contains not less than 95 percent $NaOH$, of which not more than 3 percent is Na_2CO_3; when exposed to air, absorbs carbon dioxide to form a carbonate; manufactured by treating sodium carbonate with quicklime ($Ca(OH)_2$).

It is used occasionally as a caustic. Its chief use is as a chemical. Potassium hydroxide is very similar to $NaOH$ in action and uses.

Calcium Hydroxide—Calcii Hydroxidum, $Ca(OH)_2$, (slaked lime, calcium hydrate).—Soft, white, crystalline powder, with an alkaline, slightly bitter taste. It is rarely used medicinally. It is used to make the official solution of calcium hydroxide.

Calcium Hydroxide Solution—Liquor Calcii Hydroxidi (limewater, liquor calcis).—It is used as a weak antacid, frequently in babies' formulas to correct the acidity of the milk. Dose: 15 cc. (4 fluidrachms).

Magnesium Oxide—Magnesii Oxidum, MgO, (magnesia, light magnesia).—Very bulky white powder; identical chemically with heavy magnesium oxide, U. S. P.

It is an excellent gastric antacid. In large doses it is a saline laxative. Dose: antacid, 0.25 gm. (4 grains); laxative, 4 gm. (60 grains).

Magnesia Magma—Magma Magnesiae (Milk of Magnesia).—A suspension of magnesium hydroxide containing 7 to 8.5 percent of $Mg(OH)_2$. The U. S. P. permits use of a suitable flavoring to make this preparation more palatable.

The therapeutic uses for Magnesia Magma are the same as for MgO. Dose: antacid, 4 cc. (1 fluidrachm); laxative, 15 cc. (4 fluidrachms).

CARBONATES

Drugs of this group are efficient antacids. They produce their effect by reacting with the acid, liberating carbon dioxide.

Monohydrated Sodium Carbonate—Sodii Carbonas Monohydratus.—It is occasionally used as an antacid. Its chief uses are chemical. An overdose acts as an irritant poison and may produce symptoms similar to those produced by the caustic alkalis. The treatment is the same as for caustic alkali poisoning.

Sodium Bicarbonate—Sodii Bicarbonas, $NaHCO_3$, (baking soda).—A white crystalline powder, stable in dry air but slowly decomposes in moist air; prepared by passing carbon dioxide into a very cold saturated aqueous solution of sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3.$$

It is used in the treatment of hyperacidity of the stomach and urine. Weak solutions are used frequently as irrigations and washes. Dose: 2 gm. (30 grains).

Heat should not be used to dissolve sodium bicarbonate, as this will cause the bicarbonate to change to carbonate, which produces a local irritant effect similar to the caustic alkalis.

Sodium Bicarbonate Tablets.—Dose: 2 gm. (30 grains).

Prepared Chalk—Creta Praeparata, $CaCO_3$ (drop chalk).—A white to grayish white powder, often prepared in cones. It is odorless, tasteless, and stable in air.

It is used as an effective gastric antacid; also very effective in the treatment of diarrhea. Dose: 1 gm. (15 grains).

Chalk Mixture.—Dose: 15 cc. (4 fluidrachms).

Aromatic Chalk Powder.—Dose: 2 gm. (30 grains).

Compound Chalk Powder.—Dose: 3 gm. (30 grains).

Precipitated Calcium Carbonate—Calcii Carbonas Praecipitatus (precipitated chalk), $CaCO_3$.—A fine white microcrystalline powder, odorless and tasteless.

It has the same therapeutic actions and uses as prepared chalk. Dose: 1 gm. (15 grains).

MISCELLANEOUS ANTACIDS

This group includes some of the newer drugs employed as gastric antacids, particularly those used in the treatment of peptic ulcer. These drugs are also excellent adsorbents.

Magnesium Trisilicate.—Magnesii trisilicas.

Action.—It is one of the newer gastric antacids, also an effective adsorbent.

Used in the treatment of peptic ulcer. Dose: 1 gm. (15 grains).

Magnesium Trisilicate Tablets.—Dose: 1 gm. (15 grains).

Aluminum Hydroxide Gel—Gelatum Alumini Hydroxidi (Colloidal Aluminum Hydroxide).—A white, viscous suspension.

Action.—Used in gastric hyperacidity, and peptic ulcer; in the treatment of intestinal toxemia as an adsorbent for toxins, gases, or bacteria. It also acts as a protective and demulcent, to inflamed areas of gastrointestinal tract. Dose: 8 cc. (2 fluidrachms).

Dried Aluminum Hydroxide Gel—Gelatum Alumini Hydroxidi siccum.—It has the same therapeutic action and uses as the suspension. Dose: 0.6 gm. (10 grains).

Aluminum Phosphate Gel—Gelatum Alumini Phosphatis.—A white, viscous, aqueous suspension.

Action.—It is used as a gastric antacid and demulcent in the treatment of peptic ulcer, particularly when associated with diarrhea, low phosphorus diet, or deficiency of pancreatic juice. It has less acid combining power than aluminum hydroxide gel, but it has the advantage of being capable of absorption. Dose: 8 cc. (2 fluidrachms).

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DIGESTANTS

Digestants are drugs which promote the process of digestion. They have a limited use, to replace certain substances which may be lacking for proper digestion. Hydrochloric acid, the enzymes of the stomach, pancreas, and bile are digestants.

Pancreatin.—Pancreatinum. A cream colored powder; contains enzymes, principally pancreatic amylase, trypsin, and pancreatic lipase, obtained from the fresh pancreas of the hog, sus scrofa, or the ox, bos taurus.

Action.—It is used in the treatment of various forms of digestive failure. It is capable of digesting fats, proteins, and carbohydrates. The enzyme amylase acts upon carbohydrates, trypsin upon protein, and lipase upon fats. Dose: 0.5 gm. (7½ grains).

Pepsin.—Pepsinum. Occurs as lustrous transparent yellow scales; contains a protein splitting enzyme; obtained from the stomach of the hog.

Pepsin is a normal enzyme of the stomach, necessary for the breaking down of protein. It is active only in a slightly acid medium. The HCl in the stomach supplies the necessary acid medium for the pepsin and also activates the pepsinogen to form pepsin.

It is used in combination with dilute HCl in gastric achylia and occasionally as a digestant. It is also used in the form of elixirs as vehicles in pharmacy. Dose: 0.5 gm. (7½ grains).

Pepsin and Rennin Elixir.—Dose: 8 cc. (2 fluidrachms).

Pepsin Elixir.—Dose: 8 cc. (2 fluidrachms).

Compound Pepsin Elixir—(Lactated Pepsin Elixir, Compound Digestive Elixir).—Dose: 8 cc. (2 fluidrachms).

Saccharated Pepsin.—Dose: 1 gm. (15 grains).

Rennin.—Renninum is a normal enzyme of the stomach, its function being to curdle milk, precipitating the protein casein. Obtained from calf stomach and used in yellowish-white powder.

It is used chiefly in the preparation of infant and convalescent foods. The whey left by the precipitation of the protein of the milk is often used in infants' formulas, when a protein-free formula is desired.

Ox Bile Extract—Extractum Fellis Bovis (Powdered Oxgall Extract).—A brownish-yel-

low, greenish-yellow, or brown powder, having a bitter taste.

Action.—Bile is essential for the normal digestion of fats. The normal constituents of bile are the bile salts, sodium glycocholate and sodium taurocholate; the bile pigments, bilirubin and biliverdin; cholesterol and lecithin. Of these, the most important are the bile salts, which are necessary for the absorption of fats and certain fat soluble vitamins K, D, A, and carotene. Bile salts stimulate the flow of bile and also have a stimulating effect on the intestinal musculature, producing a catharsis. Parenteral administration produces a greater intestinal stimulation than oral.

It is used as a chloretic; to promote absorption of vitamin K; in treatment of hepatic insufficiency, hepatic jaundice, and cirrhosis of the liver. Dose: 0.3 gm. (5 grains).

Ox Bile Extract Tablets.—Dose: 0.3 gm. (5 grains).

Ox Bile Extract Capsules.—Dose: 0.3 gm. (5 grains).

CATHARTICS

Cathartics are drugs which promote evacuation of the bowels. They are used primarily to empty the colon, as in the treatment of simple constipation, and to rid the intestine of any irritant or toxic substances, as in enteritis.

Cathartics may be classified:

1. According to their intensity of action, as aperients, laxatives, purgatives, hydragogues, and drastics. Cholagogues may be included here, as some promote defecation by stimulating the flow of bile.

2. According to their mechanism of action, as irritant cathartics, bulk cathartics, and emollient cathartics.

The cathartics listed here will be discussed according to their mechanism of action.

IRRITANT CATHARTICS

The irritant cathartics act by irritation of the intestinal tract. They stimulate peristaltic movements, which may lead to a rapid propulsion of the intestinal contents. The irritant cathartics will be grouped according to their active constituents, under the headings of "Emodin Cathartics," "Resinous Cathartics," "Irritant Oil Cathartics," and "Miscellaneous Cathartics."

EMODIN CATHARTICS

These cathartics have emodin as the active constituent.

Action.—They have little effect on the upper bowel, but they produce catharsis by prompting peristalsis of the colon. They are less likely to cause secondary constipation and have a tendency to restore the tone to the intestines. They are therefore cathartics of choice in the treatment of habitual constipation.

Cascara Sagrada—Cascara Sagrada (Rhamnus Purshiana, Sacred Bark).—The dried bark of rhamnus purshiana: The taste is bitter and acrid.

Cascara sagrada bark should not be used for a year after it is collected, as it contains an irritant ferment when fresh, which may cause severe griping. Cascara sagrada is the most popular of the emodin cathartics. Its action is mild and unaccompanied by discomfort.

Cascara Sagrada Extract.—Dose: 0.3 gm. (5 grains).

Cascara Sagrada Fluidextract.—Dose: 1 cc. (15 min.).

Aromatic Cascara Sagrada Fluidextract.—Dose: 2 cc. (30 min.).

Cascara Sagrada Tablets.—Dose: 0.3 gm. (5 grains).

Frangula.—The dried bark of rhamnus frangula. Frangula is an emodin cathartic similar to cascara in action.

Aloe—Aloe (aloes).—The taste is bitter and nauseous. Aloe contains as an active principle aloin, which upon hydrolysis in the intestinal tract yields emodin. It is more irritant in action than the other emodin cathartics, due to the resin contained, and may produce considerable griping. If aloin is employed, the cathartic action is milder because the resin is absent. Dose: 0.25 gm. (4 grains).

Aloin—Aloinum.—A mixture of active principles obtained from aloe. Dose: 15 mg. (¼ grain).

Rhubarb—Rheum.—Hard, round, or flattened pieces, yellowish-brown in color; has an agreeable odor and a bitter, astringent taste.

Besides emodin, rhubarb contains some tannin, which may sometimes act as an astringent and mask the cathartic action. It is sometimes prescribed with magnesia or sodium bicarbonate to neutralize the tannic acid and counteract the astringent effect. It is used in the form of its preparations as a cathartic.

Aromatic Rhubarb Syrup.—Dose: 10 cc. (2.5 fluidrachms).

Aromatic Rhubarb Tincture.—Dose: 4 cc. (1 fluidrachm).

Rhubarb and Soda Mixture.—Dose: 4 cc. (1 fluidrachm).

Alkaline Rhubarb Elixir.—Dose: 4 cc. (1 fluidrachm).

Rhubarb Fluidextract.—Dose: 1 cc. (15 min.).

Compound Rhubarb Powder.—Dose: 2 gm. (30 grains.).

Rhubarb Syrup.—Dose: 10 cc. (2.5 fluidrachms).

Rhubarb Tincture.—Dose: 4 cc. (1 fluidrachm).

Sweet Rhubarb Tincture.—Dose: 4 cc. (1 fluidrachm).

Indian Rhubarb.—Dose: 1 gm. (15 grains).

Senna—Senna (Senna leaves).—Senna is more active than cascara and may cause considerable griping, but it is considered an excellent laxative when simple evacuation of the bowel is desired. Dose: 2 gm. (30 grains).

Senna Fluidextract.—Dose: 2 cc. (30 min.).

Senna Syrup.—Dose: 8 cc. (2 fluidrachms).

Compound Senna Powder—(Compound licorice powder).—Dose: 4 gm. (1 drachm).

RESINOUS CATHARTICS

The action of the cathartics of this group depends on the irritant resins they contain.

Action.—They produce profuse watery stools, cause considerable griping, and are capable of setting up a gastroenteritis violent enough to threaten life. They are too severe to be used alone, but they are frequently combined with milder cathartics to increase their action in the treatment of obstinate constipation. They are sometimes used in the treatment of dropsy to evacuate the fluid.

Podophyllum.—Podophyllum (Mandrake, May Apple).

Action.—The resin of podophyllum is a powerful irritant, even when applied to the skin. Small amounts of the drug produce copious, soft stools usually unaccompanied by any marked intestinal irritation. Larger doses cause watery stools tinged with blood. The crude drug podophyllum is seldom used, being replaced by the official resin of podophyllin.

Resin of podophyllin has been shown by recent clinical trials to be effective in the treatment and removal of venereal warts. The application of a mineral oil suspension of the resin to the growth results in shrinking within a few hours, a noticeable decrease in size within two days, and disappearance, with little or no scarring, in from three to six days. Care must be taken to avoid application on the tissue around the warts because of the irritating effect.

Podophyllum Resin—Resina podophylli (podophyllin).—Dose: 10 mg. (1/6 grain).

Colocynth.—Colocynthis (colocynth pulp, bitter apple).

The active principles of colocynth are a resin and an alkaloidal substance. It is a powerful drastic cathartic, capable of producing poisoning in overdose. It is usually administered in combination with other cathartics. Dose: 0.125 gm. (2 grains).

Colocynth Extract.—Dose: 30 mg. (½ grain).

Compound Colocynth and Jalap Pills.—Dose: 1 pill.

Compound Colocynth Extract.—Dose: 0.25 gm. (4 grains).

Jalap—Jalapa (Jalap Root).—Has a slightly smoky odor; sweetish, acrid taste.

Jalap is a powerful, drastic cathartic, usually given in combination with other cathartics. Dose: 1 gm. (15 grains.

Jalap Resin.—Dose: 0.125 gm. (2 grains).

IRRITANT OIL CATHARTICS

Of the irritant oil cathartics, only castor oil will be discussed here. Another, croton oil, which was official in the N. F. VII, is a powerful drastic cathartic, capable of blistering the skin, and

should be administered with care, remembering that the dose is only 1 minim.

Castor Oil.—Oleum ricini—a pale yellowish or almost colorless viscid liquid, with a faint, mild odor and a bland, usually nauseating taste.

Action.—Its cathartic action is due to the presence of a fatty acid, rincinoleic acid which is split off in the intestinal tract, forming recinoleates, which produce catharsis. Castor Oil is bland and nonirritating and is sometimes used as an emollient for the skin or the eye. Dose: 15 cc. (4 fluidrachms).

Aromatic Castor Oil.—Dose: 15 cc. (4 fluidrachms).

Castor Oil Capsules.—Dose: 15 cc. (4 fluidrachms) of castor oil.

MISCELLANEOUS CATHARTICS

Phenolphthalein—Phenolphthaleinum.—Occurs as a white or faintly yellowish-white crystalline powder. It is odorless and stable in air.

Action.—Phenolphthalein acts both by its local irritant effect on the intestinal tract and by direct motor stimulation of the intestines. The greatest effect is produced on the colon, although there is some action in the small intestine. The cathartic action is not accompanied by any griping or colic. As it is tasteless and odorless, it is a pleasant cathartic to take and is an ingredient in many of the proprietary preparations, a number of which are made in the form of candy, or gum. Dose: 60 mg. (1 grain).

Phenolphthalein Tablets.—Dose: 60 mg. (1 grain).

BULK CATHARTICS

The bulk cathartics act by increasing the bulk of the intestinal contents. They are divided into saline cathartics and hydrophilic colloids.

SALINE CATHARTICS

Action.—The action of all the saline cathartics is identical. They are absorbed slowly, so they are retained in the intestinal tract for a comparatively long period. As the intestinal wall acts as a semipermeable membrane between the intestinal contents and circulation, fluid will pass between the circulation and the intestinal tract until the solution of the saline cathartic is rendered isotonic with the body fluids. Therefore, if large amounts of the salt are taken, the volume of water retained in the intestinal tract is considerable and exerts a mechanical stimulus which increases peristalsis. The contents of the colon remain liquid and are rapidly expelled.

Since the action of the salines removes a considerable amount of water from circulation, hypertonic solutions of certain cathartic salts may be given solely for their dehydrating effect. When salines are used for catharsis, sufficient water should be administered by mouth to avoid loss of water.

Magnesium Sulfate—Magnesii Sulfas, $MgSO_4.7H_2O$ (Epsom salt).—Besides being used for its salt action as a cathartic, Magnesium Sulfate is frequently employed as an anticonvulsant, as the magnesium ion acts as a depressant to the central nervous system. Dose: 15 gm. (4 drachms).

Magnesium Sulfate Injections.—Contain 46 to 53 percent $MgCO_4.7H_2O$. Dose: 1 gm. $MgSO_4.7H_2O$.

Magnesium Citrate Solution—Liquor Magnesii Citratis (Lemon Purgative).—A pleasantly flavored cathartic prepared by the reaction between magnesium carbonate and citric acid, producing an effervescent solution. Dose: 200 cc. (7 fluid ounces).

Sodium Sulfate—Sodii sulfas, $Na_2SO_4.10H_2O$ (Glauber's salt).—It is a very efficient cathartic, equal in effectiveness to Epsom Salt and superior in not being toxic after absorption, but its taste makes it the most objectionable of the saline cathartics. Dose: 15 gm. (4 drachms).

Sodium Phosphate—Sodii phosphas, $Na_2HPO_4.7H_2O$ (dibasic sodium phosphate, disodium orthophosphate, disodium hydrogen phosphate).—Colorless or white granular salt. This is the most pleasant of the saline cathartics, having a mild action. Dose 4 gm. (1 drachm).

Exsiccated Sodium Phosphate.—Dose: 2 gm. (30 grains).

Effervescent Sodium Phosphate.—Dose: 10 gm. (2.5 drachms).

Sodium Phosphate Solution.—Dose: 8 cc. (2 fluidrachms).

Potassium Sodium Tartrate—Potassii Sodii Tartras, $KNaC_4H_4O_6.4H_2O$. (Rochelle salt).—

Colorless crystals or white crystalline powder, with a cooling, saline taste. This is a rather mild, pleasant cathartic. It is an ingredient in Seidlitz powders. Dose: 10 gm. (2½ drachms).

Compound Effervescent Powders.—Pulveres effervescentes compositi (Seidlitz powders).

HYDROPHILIC COLLOIDS

Cathartics of this type are so called because they have the properties of absorbing water and swelling. They usually consist of indigestible fibers and are frequently used to augment the diet that is deficient in indigestible residue. They increase the bulk in the intestines and also act as demulcents or lubricants in facilitating the passage of the feces.

Agar—Agar (Agar-Agar).—Agar is frequently used alone, cut into small pieces and eaten as a cereal with cream and sugar, or it may be combined with a drug such as cascara sagrada to increase the cathartic action. It is also used as a culture medium for bacteria. Dose: 4 gm. (1 drachm).

Plantago Seed—Plantaginis Semen (Psyllium Seed, Plantain Seed, Flea Seed).—Psyllium seed contains a large amount of mucilage and swells in the intestines to form an indigestible emollient mass. It is usually taken whole with fruit juice, or the gelatinous mass which forms from contact with water may be mixed with foods. It should never be taken dry. The seed has a tendency to irritate the intestine enough to create a spasm. Dose: 7.5 gm. (2 drachms).

Methylcellulose—Methocel.—It is a white fibrous material, dissolving in cold water to a clear jelly which coagulates on heating and redissolves on cooling. It is nontoxic and is not absorbed from the digestive tract. Methylcelluose is used as a hydrophilic laxative.

EMOLLIENT CATHARTICS

Emollient or lubricant cathartics act by lubricating the fecal contents and preventing their excessive dehydration in the colon.

Liquid Petrolatum—Petrolatum Liquidum (Liquid Paraffin, White Mineral Oil, Heavy Liquid Petrolatum).—Mineral oil is an excellent lubricant, as it is indigestible and unabsorbable. It also emulsifies with the feces, prevents loss of water from the intestines, and thus increases bulk of the fecal masses. If large doses are taken, the oil may leak out through the anus. This may be prevented by decreasing the dose or by administering fractions of the dose at intervals during the day. Dose: 15 cc. (4 fluidrachms).

Liquid Petrolatum Emulsion.—Dose: 30 cc. 8 fluidrachms).

Phenolphthalein in Liquid Petrolatum Emulsion.—Dose: 15 cc. (4 fluidrachms).

Light Liquid Petrolatum—Petrolatum liquidum leve (light white mineral oil).—It is used occasionally as a lubricant cathartic, although its most common use is in nasal sprays.

STOMACHICS

Stomachics are drugs which improve the appetite and digestion. They act by stimulating the flow of HCl and digestive juices in the stomach. They will be considered in two groups, bitters and aromatics.

BITTERS

Bitters are drugs whose effects are due largely to their bitter taste and whose action is probably in large measure a reflex from stimulation of the gustatory (taste) nerves. Probably they also exert a mild irritant effect on the gustatory nerves and on the mucous membrane of the stomach, which further excites the gastric glands. Since the action of these drugs is due to their bitterness, any bitter substance that is not too active physiologically may have the same effect. Nux vomica and cinchona, considered elsewhere, are frequently used as bitters.

Gentian—Gentiana (gentian rood, bitter root).—Gentian has been in use for centuries and is still one of the most popular bitters. Its value is increased by its lack of toxic properties.

Compound Gentian Tincture.—Dose: 4 cc. (1 fluidrachm).

Gentian Elixir.

Glycerinated Gentian Elixir.

Gentian Extract.—Dose: 0.5 gm. (7½ grains).

Gentian Fluidextract.—Dose: 1 cc. (15 min.).

Quassia—Quassia (bitter wood).—Quassia is one of the most powerful bitters and is frequently administered in the form of an infusion. Dose: 0.5 gm. (7½ grains).

AROMATICS—CARMINATIVES

The aromatics considered here have both stomachic and carminative properties. An aromatic is a drug of a spicy fragrance, used to stimulate the appetite and digestive secretion. A carminative is a drug used to relieve flatulence (gas). The action of these drugs depends upon the volatile oil present. As aromatics they cause slight irritation of the gastric mucosa, and as carminatives they tend to promote peristalsis by irritating the intestinal tract, causing expulsion of gas.

A number of substances considered elsewhere, such as camphor, chloroform, and turpentine, are also employed as carminatives.

Cardamom Seed—Cardamomi Semen.—Cardamom is not as stimulating as other aromatics and is frequently used as an adjuvant to other carminative drugs or as a flavoring agent.

Compound Cardamom Tincture.—Dose: 4 cc. (1 fluidrachm).

Compound Cardamom Elixir.

Cardamom Oil.

Compound Cardamom Spirit.

Caraway—Carum (Caraway Fruit, Caraway Seed).—Caraway is an efficient aromatic and carminative. Its active constituent is a volatile oil.

Caraway Oil.—Dose: 0.1 cc. (1½ min.).

Capsicum—Capsicum (Cayenne Pepper, Red Pepper).—Capsicum is a powerful aromatic and carminative. It is also frequently employed as a counterirritant, usually in the form of the official ointment. In powdered form it is used as a condiment. Dose: 60 mg. (1 grain).

Capsicum Oleoresin.—Dose: 15 mg. (¼ grain).

Capsicum Tincture.—Dose: 0.5 cc. (8 min.).

Cinnamon—Cinnamomum (Saigon Cinnamon).—Ceylon cinnamon is official in the NF. It has a smaller yield of oil, about 0.5 percent, and should not be confused with the USP drug.

Cinnamon is an efficient aromatic and carminative, having a mild action on the stomach and intestines, but it is more often employed as an adjuvant, for flavoring purposes.

Cinnamon Oil.—Dose: 0.1 cc. (1½ min.).

Cinnamon Spirit.—Dose: 1 cc. (15 min.).

Cinnamon Water.

Cinnamon Syrup.

Cinnamon Tincture.—Dose: 1 cc. (15 min.).

Clove—Caryophyllus (Cloves).—Clove is a very stimulating aromatic and carminative. It is frequently used as an adjuvant with other preparations.

Clove Oil—Oleum Caryophilli.—It is used occasionally as a stomachic but most often as a toothache remedy.

Eugenol—Eugenol.—A phenol obtained from clove and other sources. It resembles oil of clove in appearance, odor, and taste. It is used mostly in dentistry for disinfecting root canals.

Peppermint—Mentha Piperita (American Mint, Brandy Mint).—Is light green to purplish brown in color, with an aromatic characteristic odor and a pungent taste, followed by a cooling sensation in the mouth. The activity of this drug depends upon its volatile oil.

Peppermint Oil—Oleum Menthae Piperitae.—Peppermint Oil is an excellent gastrointestinal stimulant, being useful in flatulence and nausea. It is also frequently used as a flavoring agent.

Menthol—Menthol.—Menthol has a cooling effect when applied locally. It also depresses certain sensory nerves, producing a local anesthetic effect. It is used to relieve itching in certain skin afflictions and also in nasal sprays in the treatment of coryza, pharyngitis, and laryngitis, for its slight antiseptic and anesthetic effect.

Peppermint Spirit—(Essence Peppermint).—Dose: 1 cc. (15 min.).

Peppermint Water.

Ginger—Zingiber (Jamaica Ginger, African Ginger, Cochin Ginger).—The activity of ginger is due to the volatile oil and a pungent principle called zingerone. Ginger is of value as a stimulant carminative in colic and as a stomachic in dyspepsia. It is frequently employed as a hot infusion, under the name "ginger tea," for the relief of intestinal colic or sometimes as a diaphoretic in colds. Dose: 0.6 gm. (10 grains).

Ginger Fluidextract.—Dose: 0.6 cc. (10 min.).

Ginger Oleoresin.—Dose: 30 mg. (½ grain).

Ginger Syrup.—Dose: 10 cc. (2.5 fluidrachms).

EMETICS

Emetics are drugs which cause vomiting, either by direct stimulation of the vomiting center in the medulla or by irritant action on the oropharyngeal and gastrointestinal tracts. Emetics are used to evacuate irritant or toxic substances from the stomach. Because of their tendency to increase bronchial secretions, some are also used as expectorants.

Certain drugs, such as mustard, zinc sulfate, copper sulfate, and tartar emetic, are useful as emetics because of their irritant action, but they are discussed elsewhere under their more important therapeutic uses.

Apomorphine Hydrochloride—Apomorphinae Hydrochloridium.—The hydrochloride of an alkaloid prepared from morphine; it is odorless.

Action.—Apomorphine produces emesis by stimulation of the vomiting center in the medulla. It is most effective when given parenterally. Vomiting usually occurs within 10 to 15 minutes after administration, preceded by nausea and salivation. Care must be taken not to give an overdose, as it has a central depressant effect and may produce collapse or death. In small doses, about $\frac{1}{60}$ gr., apomorphine may be used as an expectorant in the treatment of bronchitis. Dose: emetic, subcutaneous, 5 mg. ($\frac{1}{12}$ grain).

Ipecac.—Ipecacuanha (ipecacuanhae radix P. I.).—Ipecac contains three important alkaloids: emetine, cephaeline, and psychotrine. Cephaeline is most irritating, producing nausea and vomiting. Emetine is somewhat irritant and is capable of producing nausea, but its chief use is as an amebacide.

Ipecac is rather slow in its emetic action, requiring from 30 minutes to an hour to take effect. It is sometimes used as an expectorant and a diaphoretic. Dose: emetic, 0.5 gm. ($7\frac{1}{2}$ grains).

Ipecac Fluidextract.—Dose: 0.5 cc. (8 min.).

Ipecac Syrup.—Dose: Emetic, 8 cc. (2 fluidrachms).

Ipecac and Opium Powder—Dose: 0.3 gm. (5 grains).—The Ipecac and Opium preparations are used as diaphoretics and sedatives.

Ipecac Tincture.—Dose: 0.6 cc. (10 min.).

EXPECTORANTS

Expectorants are drugs which are used to increase bronchial secretions.

Ammonium Carbonate.—Ammonii Carbonas (Baker's Ammonia).

Action.—Taken orally, Ammonium carbonate is an irritant and causes gastritis in overdose. Injected into the circulation, it causes a rapid but brief stimulation to circulation and respiration, with a rise in blood pressure due to cardiac and vasomotor stimulation. These effects are not noticeable when it is taken orally.

Ammonium carbonate is used as an expectorant in the treatment of bronchitis. It is an ingredient in smelling salts and aromatic ammonia spirit, used for the relief of fainting spells and nausea. Dose: 0.3 gm. (5 grains).

Toxicology.—In poisoning by ammonia, the symptoms show some variation. Because of the volatility of the drug, there may be irritation of the respiratory tract as well as the alimentary canal, in some cases so intense as to cause edema of the glottis, resulting in suffocation. In such instances, immediate tracheotomy is necessary to prevent death.

Ammonium chloride, the acetates, and the citrates, sometimes used as expectorants, are discussed elsewhere under their more important use.

Antimony Potassium Tartrate—Antimonii Potassii Tartras (Tartar Emetic).—Antimony salts are very irritant to the stomach and produce nausea and sometimes severe vomiting. Tartar emetic is far too dangerous to prescribe as an emetic. It can be used as a nauseating expectorant in small doses and is an ingredient in brown mixture and compound syrup of squill. Dose: Oral, as expectorant, 3 mg. ($\frac{1}{20}$ grain); intravenous, for tropical diseases, 30 mg. increasing to 150 mg. ($\frac{1}{2}$ to $2\frac{1}{2}$ grains).

Senega—Senega (Seneca-snakeroot).—Senega causes a nausea which increases the secretions of the bronchial glands. It is an effective drug in the treatment of bronchitis. In overdose it may produce severe nausea and purging.

Senega Fluidextract.—Dose: 1 cc. (15 min.).

Senega Syrup.—Dose: 4 cc. (1 fluidrachm).

Expectorant Mixture.—Dose: 4 cc. (1 fluidrachm).

Eriodictyon—Eriodictyon (Yerba Santa).—It is used to some extent as a nauseating expectorant in the treatment of chronic bronchitis. It is used in the treatment of asthma by smoking the leaves. In pharmacy, the aromatic syrup is used to mask the bitter taste of quinine salts.

Eriodictyon Fluidextract.—Dose: 1 cc. (15 min.).

Aromatic Eriodictyon Syrup.—Dose. 8 cc. (2 fluidrachms).

Creosote—Creosotum (Creasote, Wood Creosote).—Creosote is used as an expectorant in chronic bronchitis. It may be taken orally or be administered by steam inhalations. It is a mild antiseptic and is occasionally employed as a gastrointestinal antiseptic in the treatment of fermentative gastritis and enteritis. Dose: 0.25 cc. (4 min.).

Creosote Carbonate—Creosoti Carbonas.—Its action and uses are similar to those of creosote. It is less irritating to the stomach than creosote. Dose: 1 gm. (15 grains).

Guaiacol—Guaiacol.—Guaiacol has the same therapeutic uses as creosote. It is a little less active and less unpleasant in taste and odor. Dose: 0.5 cc. (8 min.).

Potassium Guaiacolsulfonate — Potassii Guaiacolsulfonas (Thiocol).—It is employed as an expectorant to lessen coughing and increase the amount of mucus in chronic bronchitis. Dose: 0.5 gm. (7½ grains).

Potassium Guaiacolsulfonate Syrup.—Dose: 4 cc. (1 fluidrachm).

Turpentine Oil—Oleum Terebinthinae (Spirits of Turpentine).—It is used as an expectorant as a medicated vapor inhalation. It induces hyperemia and healing by its irritant action. It is also employed as a counterirritant in the form of a liniment.

Note: Rectified Turpentine oil is to be dispensed for internal use.

Rectified Turpentine Oil—Oleum Terebinthinae Rectificatum.—Oil that has become turbid should not be used. Dose: 0.3 cc. (5 min.).

Terpin Hydrate—Terpini Hydras.—Terpin hydrate is used as an expectorant to decrease the sputum in a chronic cough, particularly if the sputum is very fluid. It is less irritant and toxic and more pleasant than oil of turpentine.

Terpin Hydrate and Codeine Elixir.—Dose: 4 cc. (1 fluidrachm).

Terpin Hydrate Elixir.—Dose: 4 cc. (1 fluidrachm).

Dwarf Pine Needle Oil—Oleum Pini Pumilionis (Pine Needle Oil).—It is used as a vapor inhalant in the treatment of chronic bronchitis. Occasionally it is given orally as an expectorant. Frequently it is used in the form of nose sprays or drops in treatment of inflammation of the nasal passages.

Eucalyptus Oil—Oleum Eucalypti.—It is used as a vapor inhalant in the treatment of chronic bronchitis. In the treatment of inflammation of the nose and throat, it is used frequently in the form of nasal sprays and drops for its local anesthetic and antiseptic properties. Occasionally it is used in ointment in the treatment of certain skin diseases. Dose: 0.5 cc. (8 min.).

It has the same therapeutic uses as oil of eucalyptus.

White Pine—Pinus Alba (White Pine Bark).—The medicinal properties of white pine probably reside in the volatile oil and resin, but this is not certain. It is used as an ingredient in cough syrups. Dose: 2 gm. (30 grains).

Compound White Pine Syrup.—Dose: 4 cc. (1 fluidrachm).

Compound White Pine Syrup With Codeine.—Dose: 4 cc. (1 fluidrachm).

Benzoin—Benzoinum (gum Benjamin, benzoe).—Benzoin in the form of its preparations is used as an expectorant inhalant for various bronchitic conditions. Externally it is used as an antiseptic and protective to promote healing.

Compound Benzoin Tincture.—(Compound Tincture of Benzoin, Friar's Balsam, Turlington's Balsam).

Tolu Balsam—Balsamum Tolutanum (Balsam of tolu).—Tolu balsam is a feeble stimulating expectorant and is used as a vehicle in many cough medicines.

Tolu Balsam Syrup.—(Syrup of Tolu.)

Tolu Balsam Tincture.—(Tincture of Tolu, Tolu Tincture).

DEMULCENTS

Demulcents are bland substances which form gummy or mucilaginous solutions in water and exert a soothing effect on inflamed mucous membranes. They tend to form a coating on the mucous membrane which protects it from irritants. They are usually employed in the form of drinks or enemas and occasionally, in the treatment of inflamed throat conditions, as lozenges or gargles.

Gelatin—Gelatinum.—A substance produced by partial hydrolysis of collagen, derived from the skin, white connective tissue, and bones of animals; white or yellowish sheets, shreds, flakes, or a coarse or fine powder; very slight characteristic bouillon-like odor and taste; stable in air when dry, but subject to microbe decomposition when moist or in solution; soluble in hot water; insoluble in cold water but will absorb from 5 to 10 times its weight of water, swelling and softening.

Gelatin is used as a nutrient (protein), as a vehicle for suppositories, as coating for pills, and as an emulsifying agent.

Glycerinated Gelatin.—(Glycerin Jelly.)

Zinc Gelatin.—(Zinc Gelatin Boot.)

Absorbable Gelatin Sponge.—(Gelfoam.)

Collagen.—A class of albuminoids abundant in bones, skin, tendons, cartilage, and similar animal tissue.

Acacia—Acacia (Gum Arabic).—Acacia is used as a demulcent in the treatment of certain forms of throat and mouth irritation and occasionally intravenously in the treatment of nephritic edema. In pharmacy, it is used as an emulsifying agent and pill excipient.

Acacia Syrup.

Acacia Mucilage—Dose 15 cc. (4 fluidrachms).

Tragacanth — Tragacantha (Gum Tragacanth).—Tragacanth differs from acacia in being insoluble in water, but it absorbs water and swells into a soft paste. This is due to a gummy principle called bassorin. Alcohol does not have as much precipitating power of tragacanth as for acacia.

Tragacanth is occasionally used as a demulcent, but more commonly as an emulsifying agent and as an excipient in the manufacture of pills and troches.

Tragacanth Mucilage.

Tragacanth Glycerite.

Chondrus — Chondrus (Irish-moss). — Chondrus is used as a demulcent in treatment of diarrhea. It is also used, in the form of lotions, as an emollient for the hands, and occasionally as a nutritive, in the form of a jelly, in invalid diets.

Chondrus Extract.

Chondrus Mucilage.

Glycyrrhiza—Glycyrrhiza (Licorice Root).—It is used in the form of extract or fluid extract as a demulcent and expectorant, and in pharmacy as a flavoring agent and pill excipient.

Glycyrrhiza Extract.

Pure Glycyrrhiza Extract.

Glycyrrhiza Fluid extract.—Dose: 2 cc. (30 min.).

Glycyrrhiza Syrup.

Glycyrrhiza Elixir.

Althea—Althaea (Marsh Mallow Root).—It is used as a demulcent in cough mixtures and for relief of inflamed mucous membranes. In pharmacy it is used as a pill excipient.

Althea Syrup.

Elm—Ulmus (Slippery Elm, Elm Bark).—Elm is an excellent demulcent. It is used in the form of lozenges in the treatment of irritations of the throat and also as an infusion in the treatment of diarrhea. The powdered bark is sometimes used in the form of a poultice as an emollient application for external inflammation.

EMOLLIENTS

Emollients are bland, fatty or fatlike substances which, when applied to the skin, make it softer and more pliable. They are especially useful when the skin has a tendency to crack or chap. Some emollients, such as ointment bases, are used as vehicles to introduce drugs into the system through the skin. This method is used to administer drugs which are likely to irritate the alimentary tract. Its disadvantages are the slowness of absorption and the uncertainty of dosage. When systemic effects are desired, medicated ointments should be thoroughly rubbed into the skin to insure adequate absorption. Ointment bases are also used for application of drugs in the treatment of skin diseases.

Certain substances, like petrolatum and glycerin which are not fats, are included in this group because they have emollient properties.

Many fatty substances may become rancid upon standing and be irritating to the skin, so care must be taken to store them properly.

Cottonseed Oil—Oleum Gossypii Seminis.—It is used as an emollient and sometimes as a nutritive. It is employed in the manufacture of pharmaceutical preparations and as a cooking and salad oil.

Olive Oil—Oleum Olivae.—It is frequently used as an emollient and as a mild laxative in chronic constipation. It is a nutritive and is used in cooking. Dose: 30 cc. (1 fluid ounce).

Linseed—Linum (Flaxseed).—Flaxseed is used as an emollient, frequently in the form of a poultice. It retains the heat better than most other poultices, and the presence of the oil tends to soften the skin. The infusion is an excellent emollient. Flaxseed is also used occasionally as a laxative.

Linseed Oil—Oleum Lini (Raw linseed oil).—Raw linseed oil can be used as an emollient, but it is seldom used externally because of its drying property. It is used in pharmaceutical preparations and is sometimes employed as a laxative.

Theobroma Oil—Oleum Theobromatis (Cocoa Butter).—It is an excellent emollient in the treatment of chapped skin. It melts at body temperature and is therefore used as a suppository base.

Lard—Adeps.—The purified internal fat of the abdomen of the hog, Sus Scrofa, variety domesticus (Fam. Suidae).

Lard is used as an ointment base. On exposure to air it absorbs oxygen and becomes rancid. To prevent this, benzoin is sometimes incorporated in the lard.

Benzoinated Lard—Adeps Benzoinatus.—Lard to which 1 percent benzoin has been added as a preservative.

Wool Fat—Adeps Lanae (Anhydrous Lanolin, Refined Wool Fat).—Wool fat is used as an emollient in chafing of the skin. It is also an excellent ointment base, particularly when aqueous preparations are to be incorporated in the ointment.

Hydrous Wool Fat—Adeps Lanae Hydrosus (Lanolin).—Wool fat containing 25 to 30 percent water; yellowish white; otherwise similar to anhydrous wool fat and used for the same purposes.

Petrolatum—Petrolatum (Petroleum Jelly).—It is used as an emollient and lubricant. As an ointment base it has the advantage of not becoming rancid, but it is absorbed very slightly by the skin and therefore cannot be used as a vehicle for drugs which are to be administered by inunction.

White Petrolatum—Petrolatum Album (White Petroleum Jelly).—Petrolatum, wholly or nearly decolorized; a white or faintly yellowish unctuous mass, having the same uses as petrolatum.

Official ointment bases containing white petrolatum or yellow petrolatum:

Petrolatum rose water ointment.

White Ointment.

Yellow Ointment.

Hydrophilic Petrolatum.

Hydrophilic Ointment.—The White Ointment and Yellow Ointment are capable of taking on water and are useful in making ointments and creams containing aqueous solutions.

Paraffin—Paraffinum.—It is used chiefly in pharmacy to harden ointments.

Yellow Wax—Cera Flava (Beeswax).—Waxes are esters of fatty acids. They are usually firmer in consistence and have a higher melting point than fats. Yellow wax is used to harden ointments and suppositories.

White Wax—Cera Alba (White Beeswax, Bleached Yellow Wax).—It is yellowish white in color, but otherwise it resembles yellow wax in properties and uses.

Glycerin—Glycerinum (Glycerol).—Glycerin is used as a demulcent, an emollient, a pill excipient, a solvent, and a sweetening agent to replace syrup in pharmaceutical preparations.

Polyethylene Glycol 400.—It is used as an ingredient in Polyethylene Glycol ointment.

Polyethylene Glycol 400 Monostearate.

Polyethylene Glycol 4000.—Polyethylene Glycol 4000 is known commercially as carbowax. It is used in the preparation of Polyethylene Glycol Ointment.

Polyethylene Glycol Ointment—(Carbowax Base).—It is prepared from equal parts of Polyethylene Glycol 400 and Polyethylene Glycol 4000.

Cholesterol—(Cholesterin).—It is used as an absorbing base for the incorporation and emulsification of drugs in oils and fats.

Expressed Almond Oil—Oleum Amygdalae Expressum (Sweet Almond Oil).—It is used as an emollient.

PROTECTIVES AND INERT SUBSTANCES

Protectives are insoluble, chemically inert substances, in a fine state of subdivision, which are used locally to protect the surfaces against irritating or poisonous substances or mechanical injuries. They act mainly by preventing friction and absorbing moisture.

A number of chemically inert powders are used internally as protectives, particularly in the treatment of ulcerations and irritations of the intestinal tract.

Starch—Amylum (Corn Starch).—It is used as a desiccant dusting powder, usually combined with talc or some other dusting powder. In solution it is sometimes used as an enema in irritated conditions of the rectum. In pharmacy, it is employed as an excipient and a dusting powder for pills. It is also used as a nutrient.

Starch Glycerite.

Bentonite—Bentonitum (Wilkinite, Soap Clay, Mineral Soap).—Bentonite is used as an emulsifying agent, a protective colloid for the stabilization of suspensions, and as an adsorbent and protective powder in dermatology.

Bentonite Magma.—5 percent.

Lactose.—A sugar obtained from milk; white hard crystalline masses or a white powder.

Since it is less sweet than sucrose, it is used chiefly in infant feeding, and in pharmacy as a diluent for powders and tablets.

Talc—Talcum (Purified Talc).—It is used as a dusting powder in the treatment of irritated conditions of the skin. It is also used in pharmacy as a filtering medium and as a dusting powder for pills and suppositories.

Purified Siliceous Earth—Terra Silicea Purificata (Purified Kieselguhr, Purified Infusorial Earth).—It is too gritty to be used as a protective, but it is used in pharmacy as a filtering medium.

Purified Cotton—Gossypium Purificatum (Absorbent Cotton).—Chemically, cotton is pure cellulose. It is largely used as a mechanical protective, especially in surgery, often being medicated by soaking it in medicinal solutions and then drying. It is used in the laboratory as a filtering medium.

Bismuth Salts.—The insoluble salts of bismuth are used chiefly in the treatment of ulcerations and inflammations of the digestive tract. They are usually administered suspended in water, at intervals of 2 to 4 hours. The theory on which they are used is that they coat the crater of the ulcer and afford mechanical protection. Some bismuth salts are employed locally as a protective to the skin and open cuts. Some are effective in the treatment of syphilis, being commonly used in conjunction with arsenicals, as an adjuvant during intervals between arsenical administrations.

Toxicology.—Symptoms are ulcerative stomatitis, salivation, blue gum line, the blue sometimes becoming darker and spreading to the whole mouth, nephritis, vomiting, and possible methemoglobinemia.

Bismuth Subcarbonate—Bismuthi Subcarbonas (Basic Bismuth Carbonate).—Dose: 1 gm. (15 grains).

Bismuth Subcarbonate Tablets.—Dose: 1 gm. (15 grains) of bismuth subcarbonate.

Bismuth Subnitrate — Bismuthi Subnitras (Basic Bismuth Nitrate).—Dose: 1 gm. (15 grains).

Bismuth Magma—(Milk of Bismuth).—Dose: 4 cc. (1 fluidram).

Bismuth Subgallate—Bismuthi Subgallas (Basic Bismuth Gallate, Dermatol).—It is used chiefly as a dusting powder in the various skin diseases and wounds. It is occasionally used in the treatment of enteritis. Dose: 1 gm. (15 grains).

Bismuth Subgallate Tablets.—Dose: 1 gm. (15 grains) of bismuth subgallate.

Bismuth Subsalicylate—Bismuthi Subsalicylas (Basic Bismuth Salicylate).—It is used occasionally in the treatment of enteritis and to a considerable extent as a suspension in oil in the treatment of syphilis. Dose: Oral, gastrointestinal, 1 gm. (15 grains); intramuscular, in oil, antisyphilitic, 0.1 gm. (1½ grains).

Bismuth Subsalicylate Injection.—Dose of bismuth subsalicylate, intramuscular, 0.1 gm. (1½ grains).

Bismuth Potassium Tartrate—Bismuthi Potassii Tartras (Potassium Bismuth Tartrate).—It is used chiefly in the treatment of syphilis, administered intramuscularly either in the form of

an aqueous solution or an oil suspension. Dose: Intramuscular, 0.1 gm. (1½ grains).

Bismuth Potassium Tartrate Injection.—Official both as an aqueous solution or as a suspension in oil. Dose of bismuth potassium tartrate, intramuscular, 0.1 gm. (1½ grains).

ADSORBENTS

Adsorption is the attachment of one substance to the surface of another by the adhesion, in an extremely thin layer, of the molecules of gases, dissolved substances, or liquids to the surface of solid bodies with which they are in contact. Many powders possess adsorptive powers, and they are termed adsorbents.

Absorbents are effective in the treatment of various intestinal disorders, such as diarrhea caused by food poisoning or dysentery, chronic ulcerative colitis, and intestinal fermentation. They are also effective in the treatment of alkaloidal poisoning and poisoning by salts of certain heavy metals.

Kaolin—Kaolinum (China Clay).—A native hydrated aluminum silicate, powdered and freed from gritty particles by elutriation; a soft white or yellowish white powder or lumps, with an earthy or claylike taste. When moistened with water, it assumes a darker color and develops a marked claylike odor; insoluble in water, cold dilute acids, and solutions of alkali hydroxides.

It is used as an adsorbent in the treatment of various forms of enteritis and as a dusting powder in the treatment of certain skin afflictions, such as weeping eczema; also used as a pill excipient and diluent for oxidizing agents.

Kaolin Cataplasm.—Used as a means of applying heat and moisture to local inflammations.

Activated Charcoal—Carbo Activatus.—A fine black powder, odorless, tasteless, free from gritty matter. Whenever Carbo Ligni is prescribed activated charcoal must be used.

Action.—It is used largely in treating ailments of the gastrointestinal tract, where it overcomes hyperacidity, absorbs fermentative gases, and helps to remove irritating substances from the intestines. It is also effective as an antidote in the treatment of various poisonings. In pharmacy it is used as a filtering medium and clarifying agent.

Purified Animal Charcoal—Carbo Animalic Purificatus (Bone Black).—It has the same use as activated charcoal but is less effective. Dose: 0.3 gm. (5 grains).

IRRITANTS

Irritants are drugs which act locally on the skin to produce inflammation. They injure protoplasm, and the reaction which follows is an effort of the defense mechanism to protect the tissue. The response to the application of the irritant is an increased circulation to the affected part, accompanied by a localized vasodilation, followed by a feeling of warmth, comfort, and sometimes itching.

Irritants are classified as:

1. Rubefacients, or drugs which produce redness of the skin.
2. Vesicants, drugs which are capable of producing blisters.

Blisters are formed when the irritation has caused a wide dilation of the capillaries, permitting the plasma to escape into the extracellular spaces and collect under the skin. Drugs may possess both rubefacient and vesicant properties, depending on the concentration and period of application.

When irritant substances are used to excite a reflex influence on some part of the body other than that to which they are applied, they are called counterirritants. They help to alleviate pain, congestion, and spasms by the irritation of the skin.

Drugs are now little used to produce an irritation or counterirritation. Physical therapy is usually employed, in the form of heat pads, hot wet packs, diathermy, infrared lamps, and other methods.

Certain drugs, such as camphor, chloroform, turpentine, and methyl salicylate, are used as irritants but are discussed elsewhere under their more important uses.

Black Mustard—Sinapis Nigra (Brown Mustard).—Black mustard contains a glucoside, sinigrin, which in the presence of water is decomposed by the enzyme, myrosin, which is also present, to form allyl isothiocyanate, a very irritant principle, which is not present in the dry seed.

It is used in the form of a plaster as a counterirritant. It is also an efficient emetic, useful in the

treatment of poisons. Dose: emetic, 10 gm. (2.5 drachms).

Mustard Plaster.

Cantharides—Cantharis (Spanish Flies, Russian Flies).—Cantharides should be stored in air-tight containers. Long exposure to air causes decomposition and putrefaction, and it is also subject to insect attack. The NF cautions against the use of catharides with an ammoniacal odor.

Pharmacology.—The active constituent of cantharides is cantharidin, of which it yields about 0.6 percent. Catharidin has a blistering and reddening action. Taken internally, it has an intense irritant action on the gastrointestinal and genitourinary tract. It is infrequently used as a blistering agent and occasionally is prescribed in hair tonic for its stimulating action.

Toxicology.—Toxic doses of cantharides produce in a few minutes a burning pain in the pharynx and esophagus and a sense of stricture in the throat, followed by epigastric pain and vomiting and purging. Vomitus may be bilious or bloody; stools are mucus and bloody, accompained by rectal pain. There is a burning pain in the genitourinary tract, with a great desire to urinate; priapism is present; urine may be albuminous and scanty. The chief damaging action is on the kidneys and bladder. The treatment is symptomatic. Wash out the stomach, give mucilaginous drinks, avoid the use of oils, give saline cathartics to eliminate the poison from the intestines and opiates to aleviate pain.

Cantharides Tincture.—Dose: 0.1 cc. (1½ min.)

ASTRINGENTS

Astringents are drugs which have the power of contracting tissue, usually by the precipitation of protein. Both their penetrating power and their precipitating power are weak, so only the surface cells are affected. When applied to animal tissue, astringents combine with the protein to form a hard, insoluble coagulum. The coagulum acts as a protective covering so the astringent is unable to penetrate more deeply, and there is little or no damage to the underlying tissue. The term "astringent" is also applied to certain drugs, such as epinephrine and ephedrine, which have the power of shrinking mucous membrane and raw tissue without precipitating protein.

Astringents are divided into two groups, vegetable and mineral, according to their origin.

Therapeutic uses of astringents:

1. To check excessive secretion in diarrhea and to check excessive secretion of sweat.
2. In the treatment of a relaxed condition of the throat.
3. To stop bleeding in local hemorrhage.
4. To promote healing by mild irritation.

VEGETABLE ASTRINGENTS

The vegetable astringents owe their action to the presence of tannic acid. The drugs mentioned here, with the exception of tannic acid, are used primarily in the treatment of diarrhea. Tannic acid is not used for this purpose because it is very soluble, so that its action takes place in the stomach and is completed before it passes through the intestines. In the relatively insoluble derivatives and combinations of tannic acid, the tannin is partially protected by colloidal material against the albumins of the stomach, and it reaches the intestines in an active state.

Tannic Acid—Acidum Tannicum (Gallotannic Acid, Tannin).—Tannic acid is one of the most valuable astringents. It is used externally in the form of ointment or spray of a weak solution to check secretion in weeping ulcers, bedsores, and similar conditions; as a styptic in treatment of local hemorrhage; in ointment or suppositories in the treatment of hemorrhoids; in solutions or lozenges in the treatment of relaxed conditions of the throat: occasionally as a chemical antidote in alkaloidal or heavy metal poisonings.

Tannic Acid Glycerite.

Tannic Acid Ointment.

MINERAL ASTRINGENTS

The mineral astringents include certain acids and salts of heavy metals. Some of the organic acids do not ionize easily enough to be caustic, but they are recognized astringents. These include acetic and citric acids.

Alum—Alumen (Ammonium alum, $AlNH_4(SO_4)_2$; Potassium alum, $AlK(SO_4)_2$.—It is used extensively as a local astringent in excessive sweating, especially of the feet; also used as a styptic, as an astringent in vaginal douches, and

internally in the treatment of lead colic to precipitate the lead in the intestinal tract.

Exsiccated Alum.—(Burnt Alum).

Aluminum Sulfate—Alumini Sulfas $Al_2(SO_4)_3.18\ H_2O$.—It is used as an external astringent for practically the same purposes as alum. In pharmacy it is used in the manufacture of solution of aluminum subacetate.

Aluminum Subacetate Solution.

Aluminum Acetate Solution—(Burow's Solution).—Both of these preparations are used as astringents.

Zinc Sulfate—Zinci Sulfas, $ZnSO_4.7H_2O$ (White Vitriol).—It is used internally as an emetic. It is one of the most valuable emetics in various poisonings. It works quickly and efficiently, and there is no danger of poisoning because of the promptness of the emesis produced. Dose: Emetic, about 20 grains in a half tumblerful of water.

It is also used as an antiseptic and astringent in irrigating washes for the eye, nose, throat, urethra, and vagina.

Toxicology.—Symptoms are vomiting, retching, restlessness, state of anxiety, and extreme prostration. The treatment consists of the use of alkali carbonates as the chemical antidote, free use of demulcents, such as egg white, milk, mucilage of acacia, opiates to allay vomiting, and other symptomatic treatment.

Compound Zinc Sulfate Powder.

Zinc Chloride—Zinci Chloridum, $ZnCl_2$.—Zinc chloride is antiseptic and astringent and is used in irrigating washes for the eye, nose, mouth, urethra, and vagina.

Zinc Oxide—Zinci Oxidum, ZnO (Zinc White, Flowers of Zinc).—Zinc oxide is mildly astringent and antiseptic. It is used in the treatment of various skin diseases, where it may also have some protective action, in the form of dusting powders, ointments, lotions, and pastes.

Zinc Oxide Paste.—(Lassar's Plain Zinc Paste).

Zinc Oxide Ointment.

Zinc Oxide Hard Paste.—(Unna's Hard Zinc Paste).

Zinc Gelatin.—(Zinc Gelatin Boot).

Zinc Oxide Soft Paste.—(Unna's Soft Zinc Paste).

Zinc Oxide Paste with Salicylic Acid.

Calamine—Calamina.—It is used in the treatment of various skin afflictions in the same way as zinc oxide, in the form of lotion, ointment, and dusting powders.

Calamine Lotion.

Phenolated Calamine Lotion.

Calamine Liniment.

Calamine Ointment.

Prepared Neocalamine—Neocalamina Praeparata.—It is used for the same purposes as calamine. It has the advantage of a more stable color.

LEAD SALTS

The soluble salts of lead are actively astringent but less irritating than most of the other mineral astringents. The insoluble salts are used as mechanical protectives. In spite of their insolubility, when they are applied to raw surfaces or mucous membranes they may be absorbed in quantities large enough to produce chronic poisoning. Lead is a slow insidious, powerful poison.

Toxicology.—Acute lead poisoning results usually from swallowing a soluble lead salt, but occasionally from large doses of an insoluble lead salt. The first symptom is a persistent, sweet, metallic taste, followed by vomiting, the vomitus often milky white from the presence of lead chloride. There is epigastric pain and excessive thirst, sometimes obstinate constipation or diarrhea, the stools black from the presence of lead sulfide. Nervous symptoms or disordered circulation, with cramps in the calves of the legs and severe neuralgic pains in the extremities, paralysis, stupor, and collapse may occur.

Treatment

1. Gastric lavage with such chemical antidotes as magnesium or sodium sulfate, which form insoluble lead sulfate. If given in excess, they will also act as cathartics to rid the bowel of the poison.
2. If these are not available, sodium chloride (table salt) may be used.
3. The patient should be treated symptomatically and opiates given to relieve the pain.

Toxicology.—Chronic lead poisoning, called lead colic, occurs among people who are exposed daily to lead compounds. The symptoms are colicky pains in the abdomen, which increase in intensity until they are severe, often with retching

and vomiting, rigid and knotted abdominal wells, constipation, a white coating on the tongue, lack of appetite, and excessive thirst. Among the more important diagnostic symptoms are the blue line on the margin of the gums, although this is not always present, basophilic degeneration of red cells, wrist drop due to paralysis of the extensor muscle of the forearm, jaundice, emaciation, metallic taste in the mouth, albuminuria, hematuria, decrease in hemoglobin and red blood cells, and general weakness.

Treatment

1. Remove the source of poisoning, promote elimination of the poison with the use of drugs, such as sodium citrate, which increase the urinary excretion of lead and reduce the toxic symptoms.
2. An increased intake of calcium, together with vitamin D and phosphorus, aids in the elimination of lead from the bones.
3. Morphine may be used to relieve the pain.
4. Atropine, nitrites, and papaverine as antispasmodics.
5. Electric treatment for nervous disorders.

Lead Acetate—Plumbi Acetas, $Pb(C_2H_3O_2)_2$ (sugar of lead).—Lead acetate is seldom used as a therapeutic agent, but it is important from a toxicological standpoint and because of its laboratory use. At one time it was employed extensively as an astringent in washes and the treatment of diarrhea, but this use was discontinued because of its cumulative effect.

Lead and Opium Lotion.

Lead Subacetate Solution—(Goulard's Extract).—Both are used as embrocations.

Diluted Lead Subacetate Solution.—(Lead water).

Lead Monoxide—Plumbi Monoxidum, PbO (Litharge).—It is very seldom used in therapeutics. It is used mostly in the pharmacy and chemistry laboratory.

DIURETICS

Diuretics are drugs which increase the secretion of urine. They are used to remove fluid from the body, as in dropsy or edema, to dilute the urine and render it less irritating to the mucous membrane of the bladder, and to aid in eliminating toxic matter through the kidney. Diuretics should be employed with caution, particularly in certain inflammatory and diseased conditions like nephritis, when the kidney is frequently incapable of responding to the diuretic action.

The daily urine output in a healthy man is about 1,500 cc. The amount secreted depends upon the functional state of the kidney epithelium and the amount of blood passing through the renal artery. The blood supply to the kidney is influenced by the total quantity of blood in the body, the velocity of the blood current, the relative size of the renal artery and the general arterial system.

Diuretics are divided into three classes:

1. Saline diuretics, which increase the blood volume by their salt action.
2. Stimulant diuretics, which have a direct action on the kidney.
3. Circulatory stimulants, which increase blood pressure.

Water—Aqua, H_2O.—A clear colorless liquid, practically tasteless and odorless.

Water is a true physiological diuretic. It is seldom spoken of as a drug, although forcing fluids is recognized as a therapeutic measure. It is not employed as a diuretic in edematous conditions because it would increase the accumulation of the edema fluid.

Water may be introduced into the system through the alimentary tract or the subcutaneous tissue or by intravenous injection. In chronic cases, where immediate effect is not necessary, water may be given by mouth in large quantities; in acute conditions, it may be given by injection, usually in the form of normal saline solution.

Water ranks first on the list of solvents.

Distilled Water.

Sterile Distilled Water.—This should not be used for injection or in preparations for parenteral administration.

Water for Injection.—Used for injection and parenteral administration.

SALINE DIURETICS

Saline diuretics act by osmosis. When a concentrated salt enters the blood vessels, fluid passes into them from the surrounding tissues until the blood stream again becomes isotonic, increasing the circulating blood volume and thus producing a diuretic effect. Certain crystalloids, such as

sucrose, glucose, and urea, are effective diuretics. Some saline diuretics also produce a sudorific effect, since the elimination of the excess fluid in the blood stream is partly performed by the sweat glands.

Action.—The cations potassium and sodium play an important part in the action of the saline diuretics. Potassium is the chief cation of the intracellular fluid and is also present in small quantities in the extracellular fluid. Human serum contains about 20 mg. of the K ion in 100 cc. It cannot be replaced in the cell by any other ion. It is readily absorbed when administered either orally or parenterally. The daily diet usually supplies a sufficient quantity, as it is widely distributed in plants and animals.

The kidney rejects potassium readily, and if an excess of its salts is administered by mouth, it is excreted so rapidly that it is difficult to detect any change in the blood concentration. This action of the kidney may be the basis for the diuretic action of some potassium salts.

An increase of potassium may cause diaphoresis and increase of bronchial secretions.

Potassium is a universal depressant, affecting the central nervous system and circulation, and in sufficient doses having a direct action on all muscle fiber. As a remedial agent, it is not likely that the salts of potassium will be required for the cation effect. There is little danger of undesirable depressant effects from oral administration of moderate doses if the kidneys are normal.

Sodium is physiologically inert. It is the cation of the extracellular fluid. It is present in the body in large quantities, and apparently its function is purely osmotic, since it has no effect on tissues. Any change in the sodium concentration in the body fluid may cause abnormal fluid distribution and resulting serious disturbances.

Sodium Citrate—Sodii Citras, $Na_3C_6H_5O_7.2H_2O$—**Action.**—Citrates are used in medicine as diuretics, diaphoretics, saline expectorants, and systemic alkalinizers. In the body they counteract systemic hyperacidity. Sodium citrate is also used as an anticoagulant in blood transfusions. It is employed in the official anticoagulant solution. Dose: 1 gm. (15 grains).

Anticoagulant Sodium Citrate Solution.—Composed of sodium citrate, NaCl, and distilled water.

Anticoagulant Acid Citrate Dextrose Solution—(A. C. D. solution.—Composed of sodium citrate, citric acid, dextrose, and water for injection.

Potassium Citrate—Potassii Citras, $K_3C_6H_5O_7.H_2O$.—Occurs as transparent crystals or white granular powder, with a cooling, saline taste.

It is used for the same purposes as sodium citrate, except that it is not anticoagulant. Dose: 1 gm. (15 grains).

Potassium Acetate—Potassii Acetas, $KC_2H_3O_2$.—Potassium acetate has the same uses as sodium citrate. Dose: 1 gm. (15 grains).

Potassium Nitrate—KNO_3 (Saltpeter).—Dose: 1 gm. (15 grains).

Ammonium Acetate Solution—Liquor ammonii Acetatis (Spirit of Mindererus).—Prepared by the reaction of ammonium carbonate with diluted acetic acid.

Sodium Chloride—Sodii Chloridum, NaCl (table salt)—**Action.**—Sodium Chloride is a very effective diuretic. It causes a copious flow of urine, thus promoting excretion of toxic matter. Large amounts of an isotonic solution can be administered parenterally without materially changing the composition of the extracellular fluid because of the presence of the Na ion. It is also used to remedy conditions resulting from loss of NaCl, such as heat stroke or loss of blood by hemorrhage or surgery, to prevent dehydration in burns, sometimes in failure of gastric secretion, and occasionally to raise the blood pressure in hypotension.

Isotonic Sodium Chloride Solution—(Normal Saline Solution).—A solution of 0.90 percent NaCl.

Ringer's Solution.—(Isotonic Solution of Three Chlorides.)

Ammonium Chloride—Ammonii Chloridum, NH_4Cl (Muriate of Ammonia)—**Action.**—It is a powerful diuretic. In the liver it is converted to urea and leaves an excess of anion in the extracellular fluid. Too large a dose may cause severe acidosis. It is an effective expectorant in bronchitis. Dose: Expectorant, single dose, 0.3 gm. (5 grains); diuretic, daily dose, 4 gm. (60 grains).

Sodium Biphosphate — Sodii Biphosphas. $NaH_2PO_4.H_2O$ (Sodium Dihydrogen Phosphate, Sodium Acid Phosphate).—It is usually employed in medicine as a urine acidifier, in conjunction

with certain urinary antiseptics. Dose: 0.6 gm. (10 grains).

Methanamine and Sodium Biphosphate Tablets.—Dose: 0.3 gm. (5 grains) of each drug.

STIMULANT DIURETICS

Mercurophylline.—A white or yellow odorless powder.

Action: Mercurials are powerful and effective diuretics, acting by reducing tubular reabsorption. The release of the mercuric ion from these compounds probably accounts for their effect on the kidney. The diuretic effects of the organic mercurials seem to be increased by the addition of theophylline, and at the present almost all of the mercurial diuretics are combined with theophylline. Intramuscular injection gives the best results.

Mercurial diuretics are used mainly in the treatment of cardiac edema, sometimes in chronic nephrosis and ascites due to diseased liver.

Mecurophylline Injection — (Mercuzanthin Solution)—Injection Mercurophyllinae (Mercuzanthin).—Dose: Average dose of mercurophylline, intramuscular, an amount equivalent to: the mercuri compound, 0.1 gm. (1½ grains); theophylline, 40 mg. (⅔ grain).

Mercurophylline Tablets—(Mercuzanthin Tablets).—Dose: The mercuri compound, 80 mg. (1⅓ grains); theophylline, 30 mg. (½ grain).

Meralluride—(Mercuhydrin)—**Action.**—It is used as a mercurial diuretic in the treatment of edema associated with cardiorenal disease or nephrosis and acts by reducing the tubular resorption of water. Its use is contraindicated in acute nephritis, kidney disease associated with nitrogen retention, colitis, and myocardial infection.

Meralluride Injection—(Solution Mercuhydrin Sodium).—Dose: An amount equivalent to 39 mg. (⅔ grain) of mercuri compound and 48 mg. (¾ grain) of theophylline.

Mersalyl—(Salyrgan)—**Action.**—It is believed to be less toxic and more active than the purine-free mercurial diuretics. The presence of theophylline increases the rate and completeness of absorption. It is used to remove excess fluid in edema of congested heart failure, nephrosis, and cirrhosis of the liver.

211866°—53——26

Mersalyl and Theophylline Tablets. Dose: An amount equivalent to mersalyl, 80 mg. (1⅓ grains), and theophylline, 40 mg. (⅔ grain).

Mersalyl and Theophylline Injection.—Dose: An amount equivalent to mersalyl, 0.2 gm. and theophylline, 0.1 gm.

Juniper—Juniperus (Juniper-berries).—The activity of Juniper resides in the volatile oil. It is usually employed as a diuretic in conjunction with other drugs, particularly in the treatment of cystitis. It is very irritant and should be used with caution, as it may injure the kidneys. Dose: 4 gm. (60 grains).

Juniper Oil.

Urea—Urea, $NH_2\text{-}CO\text{-}NH_2$ (Carbamide).—A very active diuretic, used in the treatment of cardiac edema and chronic nephrosis. It is administered with fruit juices, iced drinks, or flavored syrups to mask its taste; also used in treatment of infected wounds, as it aids in the removal of necrotic tissue and has some antiseptic value. Dose: 8 gm. (2 drachms).

Dextrose—Dextrosum, $C_6H_{12}O_6.H_2O$ (d-Glucose).—As a diuretic, it is usually employed as a hypertonic solution, intravenously. It is also used in isotonic solutions as a nutritive, and in combination with saline solution to combat circulatory failure due to hemorrhage or shock.

Dextrose injection.

Dextrose and sodium chloride injection.

Sucrose.—Sucrosum, $C_{12}H_{22}O_{11}$ (Saccharum, Sugar).

Action.—As a diuretic, it is administered intravenously. It must be used with caution, as it may cause severe renal injury. It has an advantage over dextrose in that it is not metabolized when given intravenously and circulates as a foreign substance until excreted, while dextrose is the natural sugar of the body, and some of it may be deposited as glycogen in the liver. Sucrose is also used orally as a nutritive and in pharmacy as a sweetening agent and an excipient for pills, masses, and troches.

CHOLERETICS

Choleretics are drugs used for their ability to increase the volume of bile. They do not stimulate the evacuation of the gallbladder. Their ef-

fect on the secretion of bile constituents is uncertain. They may be of value to encourage drainage of the bile ducts by the removal of mucus and to keep infection from these structures in cholecystitis and other conditions involving biliary stasis not due to complete obstruction.

Dehydrocholic Acid—Acidum Dehydrocholicum (Decholin).—Dose: oral, 0.25 gm. (4 grains).

Dehydrocholic acid tablets.—Dose: 0.25 gm. (4 grains).

Sodium dehydrocholate injection.—Dose: 2.0 gm. (30 grains).

CARDIAC DRUGS

DIGITALIS GROUP

Digitalis and closely allied drugs have a powerful action on the heart muscle and are invaluable in the treatment of various forms of chronic heart disease and cardiac failure. In therapeutic doses they cause an increase in the force of the systolic beat, improving nutrition to the heart and the body generally, and a slowing of the cardiac rate, giving the heart more time to rest.

Action.—In moderate doses the cardiac drugs may produce a constriction of the arteries, but the blood pressure is seldom affected, due to the slow pulse. In patients with cardiac failure, they may cause variable changes in blood pressure. When there is an accumulation of fluid in the body, as in dropsy, the cardiac glucosides cause profuse diuresis, probably due to improved circulation.

The cardiac drugs and glucosides are used for the treatment of congestive heart failure, auricular fibrillation, and paroxysmal tachycardia.

They all act directly on the heart muscle. They diminish the size of the heart. While they increase the output of the diseased heart, they diminish the output of the normal heart. In patients with auricular fibrillation they all slow the heart rate.

The drugs of the digitalis group are assayed biologically on the pigeon, and the potency is spoken of in U. S. P. units. One U. S. P. unit is equivalent to 0.1 gm. of powdered digitalis U. S. P. The U. S. P. XIII assayed digitalis on the cat, one U. S. P. unit being equivalent to approximately 1.3 cat units.

Digitalis—Digitalis (Foxglove, Digitalis Folium, P. I.).—The most important glucosides are digitoxin, gitoxin, and gitalin.

Toxicology.—Digitalis is a cumulative drug. The symptoms of poisoning are nausea and vomiting, with muscular weakness and possible visual disturbances. The pulse is slow at first but later may become rapid and irregular.

The treatment is discontinuance of administration of the drug, keeping the patient in a recumbent position, evacuation of the stomach if necessary, and symptomatic treatment.

When digitalis is prescribed, powdered digitalis U. S. P. is to be dispensed, because it has a minimum and maximum limit of standard.

Powdered digitalis.—Dose: 0.1 gm. (1½ grains).

Digitalis capsules.—Dose: 0.1 gm. (1½ grains).

Digitalis tincture.—Dose: 1 cc. (15 min.).

Digitalis tablets.—Dose: 0.1 gm. (1½ grains).

Digitalis injection.—Dose: as recommended on label.

Digitalis extract.—Dose: 30 mg. (½ grain).

Digitalis infusion.—Dose: 6.0 cc. (1.5 fluidrachms).

Digitoxin.—Digitoxinum. Digitoxin has an advantage over digitalis in that the dose is smaller and very little nausea and vomiting are produced. In therapeutic doses it rarely produces any side effects, but in toxic doses the symptoms are similar to those of digitalis poisoning. Dose: oral, 0.1 mg. (1⁄600 grain); intravenous, to be determined according to the needs of the patient.

Digitoxin injection.—Dose: intravenous, to be determined by the physician according to the needs of the patient.

Digitoxin tablets.—Dose of digitoxin: 0.1 mg. (1⁄600 grain).

Digoxin.—Digoxinum. Digoxin, like digitoxin, produces the characteristic digitalis effects rapidly. It is given in small dosage. Overdosage may produce toxic symptoms similar to those of digitalis. Dose: oral, 0.5 mg. (1⁄120 grain); parenteral, determined by the needs of the patient.

Digoxin tablets.—Dose: 0.5 mg. (1⁄120 grain).

Digoxin injection.—Dose: intravenous, to be determined by physician.

Lanatoside C.—Lanatosidum C. A glucoside obtained from the leaves of Digitalis lanata (Fam.

Scrophylariaceae). White crystals or crystalline powder, insoluble in water.

Its use is similar to that of digoxin. Dose: oral, 0.5 mg. (1/120 grain); parenteral, suited to needs of patient.

Lanatoside C injection.—Dose: to be determined by the physician according to the needs of the patient.

Lanatoside C tablets.—Dose of Lanatoside C: oral, 0.5 mg. (1/120 grain).

Strophanthus.—Strophanthus (Strophanthus Seed).

Action.—Its use is similar to that of digitalis, but since its action is unpredictable it is very seldom used. It is the only drug of the digitalis group which is assayed on the frog. Dose: 60 mg. (1 grain).

Strophanthus Tincture.—Dose: 0.5 cc. (8 min.).

Strophanthin.—Strophanthinum. It is used intravenously for quick digitalization of the patient in cases of immediate danger . If the patient has recently taken digitalis, strophanthin should be administered with great caution. Dose: 0.6 mg. (1/100 grain).

Strophanthin injection.—Dose: intravenous, 0.6 mg. of strophanthin.

Ouabain — Ouabainum. (G-Strophanthin).—The action of Ouabain is similar to digitalis but much more powerful. It is not suitable for continuous administration, but only for quick digitalization. It is administered only parenterally, because its absorption from the intestinal tract is so slow and irregular that it is impractical to give it orally. It is also used as a reference standard for drugs of the digitalis group. Dose: intravenous, 0.25 mg. (1/250 grain).

Ouabain injection.—Dose: intravenous, 0.25 mg. (1/250 grain) of Ouabain.

Quinidine sulfate.—Quinidinae Sulfas.

Action.—Quinidine Sulfate is a cardiac drug, but its action differs somewhat from that of the digitalis group. It is a depressant to the cardiac muscle and is used extensively in the treatment of auricular fibrillation and paroxysmal tachycardia. It resembles quinine in being a general protoplasmic poison, in its antipyretic and oxytocic action, and its antimalarial properties. Dose: 0.2 gm. (3 grains).

Quinidine sulfate tablets.—Dose: 0.2 gm. (3 grains).

Quinidine sulfate capsules.—Dose: 0.2 gm. (3 grains).

ACONITE GROUP

This group includes two drugs, aconite and veratrum viride. They cause a slowing of the pulse by stimulation of the cardio-inhibitory center, resulting in a lowering of the blood pressure, often accompanied by sweating. They differ from digitalis in not stimulating the heart or the vasomotor center.

Aconite.—Aconitum (Aconite Root, Monkshood, Wolfsbane, Aconiti tuber P. I.).—Aconite is infrequently employed as a cardiac depressant. The drug and its preparations are often used as a diaphoretic in febrile conditions and locally as an anodyne. Dose: 60 mg. (1 grain).

Toxicology.—In large doses Aconite is a rapid and dangerous poison. The symptoms include a feeling of warmth in the stomach, with or without vomiting, intense weakness, slow respiration, soft, slow pulse which becomes rapid and irregular toward the end. The most characteristic symptom is the peculiar prickling sensation on the tongue and lips, passing to the extremities.

Treatment

1. Keep the patient lying down.
2. Empty the stomach with a stomach pump.
3. A chemical antidote such as Lugol's solution or potassium permanganate may be of some value.
4. Symptomatic treatment should follow.

Aconite fluidextract.—Dose: 0.06 cc. (1 min.).

Aconite tincture.—Dose 0.6 cc. (10 min.).

Veratrum viride.—Veratrum Viride (Green Hellebore, American Hellebore).

It is occasionally used to lower the pulse rate in various forms of tachycardia. Dose: 0.1 gm. (1½ grains).

Toxicology.—The symptoms of Veratrum poisoning are violent vomiting accompanied by retching, much nausea, and prostration. In the early stages the pulse is very slow, later becoming rapid and irregular. The skin is moist and pale, the respiration shallow and stertorous. The reflexes are diminished, and muscular weakness is prevalent.

Treatment

1. The patient should be kept in a horizontal position.
2. A stomach pump used to evacuate the stomach.
3. Use of a chemical antidote, such as Lugol's solution or charcoal, and of atropine as a physiological antidote is recommended.
4. Followed by symptomatic treatment.

Veratrum Viride Tincture.—Dose: 1.0 cc. (15 min.).

VASODILATORS

These drugs open up blood vessels or increase the force of the heart beat.

NITRITES

The nitrites relax smooth muscles, especially of the finer blood vessels. A fall in blood pressure is the most important pharmacological action. Their relaxation of the coronary arteries is the basis of their chief use in the relief of pain in angina pectoris. Their action on the blood vessels of the skin produces flushing and sweating. They may produce headache, probably by dilation of the smaller vessels of the meninges, which increase the cranial pressure. They also relax the smooth muscles of the gastrointestinal and genitourinary tracts. Because of their action on the bronchial muscles, they are used in the relief of bronchial spasm.

Large doses of nitrites convert hemoglobin to methemoglobin. In the treatment of cyanide poisoning, where this effect is desired, sodium nitrite or amyl nitrite is used.

Toxicology.—Large doses produce irritation of the stomach, nausea and vomiting, severe headache, confusion, slow pulse, shallow and irregular but somewhat accelerated respiration and methemoglobin.

Treatment

1. If the nitrites were taken orally, use gastric lavage.
2. Inhalations of oxygen.
3. Injection of a small dose of methylene blue.
4. Blood transfusion if methemoglobin is present.
5. Keep the patient's head low.
6. Treat symptomatically.

Amyl Nitrite.—Amylis Nitris (Isoamyl Nitrite, Pearl of Amyl Nitrite). Amyl Nitrite is used where immediate vasodilation is desired, especially in angina pectoris. It increases the circulation in the coronary arteries while lowering the blood pressure. Dose: inhalation, 0.2 cc. (3 min.).

Sodium Nitrite.—Sodii Nitris, $NaNO_2$.

It is used chiefly in the treatment of arterial hypertension. Its action is very slow, apparently in about 10 minutes and lasting about 2 hours. Dose: 60 mg. (1 grain).

Sodium Nitrite Tablets.—Dose: 60 mg. (1 grain).

Glyceryl Trinitrate Tablets—Tabellas Glycerylis Trinitratis, $C_3H_5(NO_3)_3$ (Nitroglycerin Tablets).—Glyceryl trinitrate acts very quickly, the blood pressure dropping within 2 or 3 minutes after oral administration, the action being completed in about ½ hour.

It is used where rapidity of action is desired, as in angina pectoris, threatened apoplexy, and asthma. It should be administered with caution, as it may produce severe headache. Dose: 0.4 mg. (1/150 grain).

Glyceryl Trinitrate Spirit.—Spiritus Glycerylis Trinitratis (Spirit of Nitroglycerin, Spirit of Glonion).—It is highly explosive. If tasted or allowed to touch the skin it may cause severe headache.

It has the same uses as the tablets. Dose: 0.06 cc. (1 min.).

Erythrityl Tetranitrate Tablets—Tabellae Erythritylis Tetranitratis, $C_4H_6(NO_3)_4$ (Erythrol Tetranitrate Tablets, Tetranitrol Tablets).—The vasodilating effects of Erythrityl Tetranitrate are less marked but more prolonged than those of other nitrites.

It is used to lower the blood pressure in various circulatory disturbances where constant effect is desired. Dose: 30 mg. (½ grain).

Ethyl Nitrite Spirit—Spiritus Aethylis Nitritis (Sweet Spirit of Nitre, Spirit of Nitrous Ether).—It is volatile and flammable and decomposes when exposed to air.

It has the same action as the other nitrites, but it is used mainly as diaphoretic in mild fevers, especially in children. Dose: 2.0 cc. (30 min.).

Mannitol Hexanitrate Tablets.—Mannitol Hexanitrate is an explosive compound formed by the nitration of mannitol. It is much less stable than nitroglycerin. Its use in pharmaceutical preparations is in 10-percent mixture of carbohydrates in which it is nonexplosive. Dose: 30 mg. (½ grain).

MISCELLANEOUS VASODILATORS

Sodium Thiocyanate.—Sodii Thiocyanas, NaSCN (Sodium Sulfocyanate).

Action.—Thiocyanates have two major actions in the body. They are similar to iodides, causing cutaneous and mucosal effects characteristic of iodism. They act like nitrites in relaxing the smooth muscles and are employed for this effect in the treatment of essential hypertension. They must be used cautiously because the rate of excretion is variable and unpredictable, so there is danger of cumulative toxicity, and the dose cannot be relied upon as an index of safety. The patient should be carefully observed and the serum level of the thiocyanate ion controlled. Dose: 0.3 gm. (5 grains).

Toxicology.—Symptoms of thiocyanate poisoning are weakness of the arms and legs, aching and cramps of the calf muscles, nervousness and irritability, mild gastrointestinal complaints, and symptoms of iodism such as coryza and dermatitis. More severe reactions produce stuttering, loss of speech, hallucinations, confusion, and delirium. In chronic reactions there is secondary anemia, loss of weight, and muscular wasting.

Treatment

1. Discontinue the use of the drug.
2. Treat symptomatically.

Sodium Thiocyanate Elixir.—Dose: 4.0 cc. (1 fluidrachm).

Potassium Thiocyanate—Potassii Thiocyanas, KSCN (Potassium Sulfocyanate).—Has the same action and uses as sodium thiocyanate. Dose: 0.3 gm. (5 grains).

Histamine Phosphate.—Histaminae Phosphas (Histamine Acid Phosphate).

Action.—Histamine is widely distributed in plants and animals. It is a powerful vasodilator, but its many other actions make it unfit for therapeutic use. It lowers the blood pressure but has no direct pronounced heart action. Large doses may produce such a decided fall in blood pressure as to cause shock. The primary cause of histamine shock is the dilation of the capillaries, allowing the escape of plasma from the blood stream and causing a difference between the volume capacity of the circulatory system and the circulating blood volume. Many other varieties of shock are due to this action. In traumatic shock, histamine is released in the body as a result of injury to the tissue cells. In anaphylactic shock, intracellular reaction between the antigen and antibody injures the cell, liberating histamine.

Histamine constricts the bronchioles by direct muscular action. Patients suffering from asthma, emphysema, and bronchitis are most seriously affected. It stimulates the gastric glands by causing an increase in the secretion of gastric juices, and it has a slight stimulating effect on the salivary glands and the intestinal secretions.

It is used as a diagnostic agent in gastric function tests. It is also used to determine the circulatory velocity and in the desensitization of certain allergic types of headache, chronic urticaria, and cold sensitivity. Dose: 0.3 mg. (1/200 grain).

Toxicology.—Histamine poisoning is rare, usually the result of an error in dosage. The symptoms are alarming but not very dangerous. There is a fall in blood pressure, with intense headache, bronchial constriction, dyspnea, a metallic taste in the mouth, vomiting, diarrhea, and in severe cases, shock.

Treatment

1. Prompt administration of epinephrine, the physiological antidote.
2. Restoration of the blood volume if shock occurs.
3. Symptomatic treatment.

Histamine Phosphate Injection.—Dose of Histamine Phosphate: intramuscular, 0.3 mg. (1/200 grain).

Histidine Monohydrochloride.—Dose: 0.2 gm. (3 grains).

Histidine Monohydrochloride Injection.—Dose: 0.2 gm. (3 grains).

VASOCONSTRICTORS

Vasoconstrictors cause a constriction of the blood vessels. They act on the same mechanism as the vasodilators. They are used to raise the blood pressure, but they have several other uses. Some of them will be discussed elsewhere under their more important pharmacological actions.

Naphazoline Hydrochloride.

Action.—The strong solution should be used only by adults. Only a few drops should be instilled in each nostril and the treatment should not be repeated for several hours.

The mild solution is for use by children.

These solutions should not come in contact with aluminum.

Mild Naphazoline Hydrochloride Solution.—(Mild Privine Hydrochloride Solution 0.05 percent.)

Strong Naphazoline Hydrochloride Solution.—(Strong Privine Hydrochloride Solution 0.1 percent.)

CENTRAL NERVOUS SYSTEM STIMULANTS

Certain drugs stimulate the activity of various portions of the central nervous system. They differ in site and mechanism of action. They are not employed exclusively as central nervous system stimulants because they have many other actions. The central nervous system can be stimulated only for a brief period as the excitation is soon followed by depression.

Nux Vomica—Nux Vomica (Quaker Buttons, Dog Buttons).—Nux Vomica contains two alkaloids, strychnine and brucine. Its activity resides in strychnine, brucine being relatively weak.

Action.—Strychnine is a powerful stimulant to the central nervous system, particularly the spinal cord and medullary centers. The stimulation of the spinal cord leads to increased activity of the reflexes, and in large doses causes convulsions. Strychnine is a valuable respiratory stimulant and is used an an antidote in poisoning by central nervous system depressants, like the hypnotics. It is also used as a stomachic and bitter.

Toxicology.—The first symptom of strychnine poisoning is a feeling of stiffness in the face and neck muscles, followed by an increased reflex activity, the smallest stimulus causing a violent response leading to a convulsion. The body is rigid, with the trunk arched backward, the arms flexed, the legs extended, the jaw closed, and the facial muscles drawn into a sardonic grin. Spasm of the abdominal and thoracic muscles is accompanied by arrest of respiration. The eyes bulge, the pupils are contracted, and cyanosis is present. The patient is conscious and in pain and is apprehensive of death. The convulsions last slightly over a minute, then the muscles relax and there is a period of depression, followed in 10 to 15 minutes by another convulsion. Death usually follows the second to fifth convulsion as a result of asphyxia.

Treatment

1. Prevention or control of the convulsions.
2. Quick acting barbiturates, such as amytal sodium administered intravenously, are effective.
3. If these are not available, chloral hydrate, paraldehyde, inhalations of chloroform, or tribromoethanol may be used.
4. After the convulsion has subsided, gastric lavage may be employed to remove the poison from the stomach.
5. Potassium permanganate may be given as a chemical antidote.
6. The patient should be kept under close observation and treated symptomatically.

Strychnine.—Dose: 1.5 mg. (1/40 grain).

Strychnine Nitrate.—Dose: 2 mg. (1/30 grain).

Strychnine Phosphate.—Dose: 2 mg. (1/30 grain).

Strychnine Sulfate.—Dose: 2 mg. (1/30 grain).

Nux Vomica Extract.— Dose: 15 mg. (1/4 grain).

Nux Vomica Fluidextract.—Dose: 0.1 cc. (1½ min.).

Nux Vomica Tincture.—Dose: 1.0 cc. (15 min.).

Picrotoxin—Picrotoxinum (Cocculin).—Picrotoxin is a powerful stimulant to the central nervous system, resembling strychnine in action. It is used intravenously in the treatment of poisoning by hypnotic drugs such as barbiturates, chloral, paraldehyde, or sulfonal. Dose: intravenous, to be determined according to the needs of the patient.

The toxic symptoms resemble those of strychnine poisoning and the treatment is the same.

Picrotoxin Injection.—Dose: intravenous, to be determined by the physician according to the needs of the patient.

Nikethamide (Coramine).

Action.—It is used both orally and by injection as a respiratory stimulant and as a stimulant in acute circulatory failure not associated with cardiac disease. It has been used as an antidote in barbiturate poisoning with favorable results. Dose: 0.5 gm. (7½ grains).

Nikethamide Injection.—Dose: 0.5 gm. (7½ grains).

Pentylenetetrazol. — (Pentamethylenetetrazol, Metrazol).

Action.—It has a powerful stimulating action on the mid-brain and the medullary centers. It is used in the treatment of barbiturate poisoning. It is also used in the shock therapy of mental disorders. It is given orally and by parenteral injection.

Pentylenetetrazol Injection.—Dose: To be determined by the physician.

Camphor.—Camphora (Gum Camphor).

Action.—Camphor is a stimulant to the central nervous system, having a more marked effect on the higher centers. Therapeutic doses have little effect on respiration and its effect on the heart is variable, but it is still frequently used as a circulatory and respiratory stimulant by injection. In the form of a liniment, it is used as a rubefacient and counterirritant, and it also has a mild anesthetic action on the skin. It is frequently employed in the form of the spirit for application to herpes on the lips. It is occasionally incorporated in ointments as an antipruritic. Official Camphor Water is used in eye washes for its cooling and soothing effect.

Camphor and Soap Liniment.—(Soap Liniment).

Camphor Liniment.—(Camphorated Oil).

Camphor Water.

Camphor Injection—(Camphor in Oil Ampuls).—Dose: 0.2 gm. (3 grains).

Camphor Ointment.—22 percent.

Camphor Spirit.—Dose: 1 cc. (15 min.).

XANTHINE DERIVATIVES

Caffeine, theophylline, and theobromine are called Xanthines. They are all stimulants to the central nervous system, caffeine the strongest and theobromine the weakest.

Action.—The xanthines affect the circulation. They stimulate the heart muscle directly, cause a relaxation of the coronary vessels, and tend both to constrict the blood vessels by vasomotor stimulation and to dilate them by direct effect on the vascular musculature. The end result of these contradictory actions is a slight increase in pressure. These drugs relax the smooth muscles, particularly the bronchi and the biliary tract. They also act as diuretics.

Caffeine.—Caffeina (Theine).

Action.—Caffeine stimulates all parts of the central nervous system, especially the cortex, medulla, and spinal cord. Its action on the cortex produces a clearer and more rapid flow of thought and allays drowsiness and fatigue. It stimulates respiratory, vasomotor, and vagal centers in the medulla.

It is used as a cardiac and respiratory stimulant, as a diuretic in the treatment of dropsy, and for relief of headache. Dose: 0.2 gm. (3 grains).

Caffeine and Sodium Benzoate.—Dose: 0.5 gm. (7½ grains).

Caffeine and Sodium Benzoate Injection.—Dose of caffeine and sodium benzoate: intramuscular, 0.5 gm. (7½ grains).

Citrated Caffeine.—Dose: 0.3 gm. (5 grains).

Caffeine and Sodium Salicylate.—Dose: 0.2 gm. (3 grains).

Theophylline—Theophyllina (Theocin).—It is used as a vasodilator in treatment of coronary thrombosis and angina pectoris. It is also employed to relieve the spasms of bronchial asthma and occasionally as a diuretic. Dose: 0.2 gm. (5 grains).

Theophylline and Sodium Acetate.—Dose: 0.2 gm. (3 grains).

Theophylline and Sodium Acetate Tablets.—Dose: 0.2 gm. (3 grain).

Aminophylline—(Theophylline Ethylenediamine).—Dose: oral, 0.2 gm. (3 grains); intravenous or intramuscular, 0.25 gm. (4 grains); rectal, 0.5 gm. (7½ grains).

Aminophylline Injection.—Dose: intramuscular and intravenous, 0.25 gm. (4 grains).

Aminophylline Suppositories.—Dose: 0.5 gm. (7½ grains).

Aminophylline Tablets.—Dose: 0.2 gm. (3 grains).

Theobromine—Theobromina.—A white crystalline powder.

Theobromine and Sodium Acetate—Theobromina et Sodii Acetas.—It is used as a vasodilator in conditions of the coronary artery, as a diuretic, and as a cardiac stimulant. Dose: 0.5 gm. (7½ grains).

Theobromine and Sodium Acetate Tablets.—Dose: 0.5 gm. (7½ grains).

Theobromine and Sodium Acetate Capsules.—Dose: 0.5 gm. (7½ grains).

Theobromine and Sodium Salicylate—(Diuretin).—Dose: 1 gm. (15 grains).

Theobromine Calcium Salicylate—(Theocalcin).—Dose: 0.5 gm. (7½ grains).

Theobromine Calcium Salicylate Tablets.—Dose: 0.5 gm. (7½ grains).

CENTRAL NERVOUS SYSTEM DEPRESSANTS

BARBITURATES

Action.—The barbiturates are a widely used group of central nervous system depressants. They all have the same general action, differing in rapidity, degree, and duration. Their effects range from mild sedation to deep coma. They also produce respiratory depression. Large doses may cause vasodilation accompanied by a fall in blood pressure, injure the liver, and have an antidiuretic effect. The barbiturates are detoxified by the liver and excreted by the kidney. In some cases they are habit forming.

They are used as hypnotics and sedatives, as anticonvulsants, as anesthetics for short or basal anesthesia, and in combination with analgesics to increase their effects. They are administered orally, rectally, subcutaneously, or intravenously.

Toxicology.—Poisoning by barbiturates is characterized by deep sleep or coma, slow respiration, weak, rapid pulse, a fall in body temperature, and moist cold, cyanotic skin. The capillaries may dilate, and in the later stages shock may ensue. Death occurs from respiratory failure.

Treatment

1. If the barbiturate was taken orally, gastric lavage should be used.
2. Followed by magnesium sulfate to act as a cathartic.
3. Physiological antidotes such as picrotoxin, strychnine, caffeine, ephedrine, or coramine should be given to counteract the depressant effects on the respiration and central nervous system.
4. The patient should be treated symptomatically.

Barbiturates are cumulative poisons and are capable of causing chronic poisoning, with symptoms of drowsiness, failing memory, mental depression, incoherent speech, and disorientation. There may also be various nervous and gastrointestinal disorders, skin rashes, pruritis, loss of weight, and casts and albumin in the urine. The treatment consists of stopping the drug, hospitalization of the patient, and symptomatic treatment.

Amobarbital—Amobarbitalum (Amytal, Isoamyl Ethyl Barbituric Acid).—Dose: 30 mg. (½ grain).

Amobarbital Tablets.—Dose: 30 mg. (½ grain).

Amobarbital Elixir.—Dose: 4 cc. (1 fluidrachum).

Amobarbital Sodium.—Dose: 60 mg. (1 grain).

Amobarbital Sodium Capsules.—Dose: 60 mg. (1 grain).

Sterile Amobarbital Sodium.

Barbital—Barbitalum (Diethylbarbituric Acid, Barbitone, Veronal, Diethylmalonylurea).—Barbital is a slow-acting barbiturate and should be taken about 2 hours before sleep is desired. It is used as a hypnotic, sedative, and anticonvulsant. Dose: 0.3 gm. (5 grains).

Barbital Tablets.—Dose: 0.3 gm. (5 grains).

Barbital Sodium—(Soluble Barbital).—Dose: 0.3 gm. (5 grains).

Barbital Sodium Tablets.—Dose: 0.3 gm. (5 grains).

Barbital Elixir.—Dose: 4 cc. (1 fluidrachm).

Phenobarbital—Phenobarbitalum (Phenylethylmalonylurea; Luminal, Phenobarbitone).—Phenobarbital acts slowly. It is more powerful than barbital, but its uses are similar. Dose: 30 mg. (½ grain).

Phenobarbital Tablets.—Dose: 30 mg. (½ grain).

Phenobarbital Sodium—(Soluble Phenobarbital).—Dose: 30 mg. (½ grain).

Phenobarbital Sodium Injection.—Dose: 30 mg. (½ grain).

Phenobarbital Sodium Tablets.—Dose: 30 mg. (½ grain).

Sterile Phenobarbital Sodium.

Phenobarbital Elixir.—Dose: 4 cc. (1 fluidrachm).

Pentobarbital Sodium—Pentobarbitalum Sodicum (Soluble Pentobarbital, Nembutal).—It acts rapidly and has the same uses as the other barbiturates. Dose: 0.1 gm. (1½ grains).

Pentobarbital Sodium Capsules.—Dose: 0.1 gm. (1½ grains).

Pentobarbital Sodium Injection.—Dose: 0.1 gm. (1½ grains).

Sterile Pentobarbital Sodium.—Dose: 0.1 gm. (1½ grains).

Pentobarbital Sodium Tablets.—Dose: 0.1 gm. (1½ grains).

Pentobarbital Elixir.—Dose: 4 cc. (1 fluidrachm).

Thiopental Sodium.—Thiopentalum Sodicum (Thiopentone Soluble, Pentothal Sodium).

Action.—Thiopental Sodium acts quickly and is used intravenously for anesthesia in operations of short duration. It should be injected slowly by an experienced person. It is sometimes used to control convulsions in strychnine poisoning. For parenteral use the sterile thiopental sodium should be used, mixed with anhydrous sodium carbonate as a buffer.

Sterile Thiopental Sodium.—Dose: To be determined by the physician according to the needs of the patient.

BROMIDES

The bromide ion is a depressant to nerve tissue, but it shows a selective action for the spinal cord. Small doses affect the motor area of the cerebrum; larger doses cause depression of the sensory side of the spinal cord; very large doses cause some mental confusion.

Bromides are used:

1. As sedatives to relieve nervousness and encourage sleep. They are not true somnifacients but induce sleep by lessening the activity of perception of sense stimuli.

2. As anticonvulsants, particularly in epileptic seizures. They may be used in tetanic convulsions, but their action is rather slow for this purpose.

3. As a sedative to allay pain, control seasickness or vomiting in pregnancy, and to lessen sexual hyperesthesia.

Toxicology.—Excessive use may produce symptoms of chronic poisoning, known as bromidism. The characteristic symptoms are an acnelike eruption of the skin, fetid breath, occasional mental confusion, and muscular weakness. The treatment consists of complete withdrawal of the drug, large doses of sodium chloride, and symptomatic treatment.

Sodium Bromide—Sodii Bromidum, $NaBr$.—Dose: 1 gm. (15 grains).

Sodium Bromide Tablets.—Dose: 1 gm. (15 grains).

Potassium Bromide—Potassii Bromidum, KBr.—Dose: 1 gm. (15 grains).

Ammonium Bromide—Ammonii Bromidum, NH_4Br.—Dose: 1 gm. (15 grains).

Calcium Bromide—Calcii Bromidum, $CaBr_2$.—Dose: 1 gm. (15 grains).

Lithium Bromide—Lithii Bromidum, $LiBr$.—Dose: 1 gm. (15 grains).

Strontium Bromide—Strontii Bromidum, $SrBr_2{\cdot}6H_2O$.—Dose: 1 gm. (15 grains).

Official preparations of bromides:

Three Bromides Elixir.—Dose: 4 cc. (1 fluidrachm).

Three Bromides Tablets.

Five Bromides Elixir.—Dose: 4 cc. (1 fluidrachm).

Bromides Syrup.—Dose: 4 cc. (1 fluidrachm).

Ammonium Bromide Elixir.—Dose: 4 cc. (1 fluidrachm).

Potassium Bromide Elixir.—Dose: 4 cc. (1 fluidrachm).

Sodium Bromide Elixir.—Dose: 4 cc. (1 fluidrachm).

MISCELLANEOUS DEPRESSANTS

Diphenylhydantoin Sodium.—Diphenylhydantoinum Sodium (Soluble Phenytoin, Dilatin Sodium).—It is used as an anticonvulsant in treatment of epilepsy and is preferred to phenobarbital because it has no hypnotic properties. Occasionally it is combined with phenobarbital to increase its action.

Toxicology.—Dilantin sometimes produces toxic symptoms, such as giddiness, ataxia, nervousness, visual disturbances, slurring of speech, confusion, drowsiness, headache, dyspnea, difficulty in swallowing, acute gastric disturbance, dermatitis, and hyperplasia of the gums. These symptoms are not serious and usually subside upon withdrawal of the drug. Dose: 0.1 gm. (1½ grains).

Diphenylhydantoin Capsules.—Dose: 0.1 gm. (1½ grains).

Trimethadione.—It is an anti-epilepic drug which acts as an anticonvulsant. Dose: 1.0 gm. (15 grains).

Trimethadione Capsules—(Tridione Capsules).—Dose: 1.0 gm. (15 grains).

Trimethadione Tablets.—Dose: 1.0 gm. (15 grains).

Chloral Hydrate—Chloralis Hydras, $CCl_3CH(OH)_2$.—It is used as a sedative and hypnotic. In therapeutic doses it causes sedation in 10 to 15 minutes and sleep within an hour. Dose: 0.6 gm. (10 grains).

Toxicology.—The symptoms are deep stupor, marked vasodilation, low blood pressure, fall in body temperature, slow respiration, and cyanosis; occasionally there is delirium or collapse. Gastric irritation may be followed by vomiting. Death results from respiratory failure.

Treatment

1. Gastric lavage.
2. Warmth.
3. Stimulants as prescribed for barbiturate poisoning.

Chlorobutanol—Chlorobutanol, $Cl_3C.C(CH_3)_2OH$.—It is used as a hypnotic and sedative. It is given orally to allay vomiting due to gastritis. It is also somewhat effective in the treatment of motion sickness. Frequently it is used in the form of a dusting powder or ointment for its local anesthetic effect. Sometimes it is employed as a preservative in solutions of epinephrine, posterior pituitary, and other drugs. Dose: 0.6 gm. (10 grains).

Paraldehyde—Paraldehydum.—The action of Paraldehyde is similar to that of chloral hydrate. It is a hypnotic and sedative, producing normal sleep, without after effects, in from 10 to 15 minutes. Its hypnotic effects are not as potent as those of chloral, and large doses do not depress respiration.

Paraldehyde has a wide margin of safety, and although excessive doses may cause prolonged unconsciousness, fatalities are rare. The drug should be administered well diluted in a proper vehicle to avoid throat and gastric irritation. Dose: 4 cc. (1 fluidrachm).

Urethan—Urethanum (Ethyl Carbamate).—Urethan is a weak anesthetic and is inconsistent in its action. It is used in the preparation of quinine and urethan injection to increase the solubility of the quinine hydrochloride. It is also employed to anesthetize animals in the laboratory.

Alcohol—Alcohol, C_2H_5OH (Ethanol, Ethyl Alcohol, Spiritus Vini Rectificatus).—Alcohol is a product of fermentation of sucrose by certain yeast enzymes. It may also be prepared synthetically.

Action.—Locally, alcohol injures the tissue cells by precipitating and desiccating protoplasm. It is irritant to open cuts and mucosa. When applied to the skin, it evaporates with a cooling effect. If applied by rubbing, it produces a mild redness and burning. Injected hypodermically, it causes local anesthesia.

Systemically, alcohol is a narcotic. Although in small doses it stimulates the gastric mucosa, increasing the flow of juices, its effect on the central nervous system is progressively depressing. The respiration and heart are slightly affected by a small dose, but continuous small doses produce hypnotic effects. Alcohol causes vasodilation, resulting in a warm, flushed skin and a feeling of surface warmth, but it lowers the body temperature. When large amounts are ingested, the fall in temperature is very pronounced. High concentrations of alcohol injure the kidney epithelium. Alcohol is a hydrocarbon and is oxidized in the body, yielding energy, so it may be considered a food. It cannot be stored or utilized to build tissue, but by yielding energy it lessens consumption of other foodstuffs and encourages storage, and therefore chronic alcoholics show signs of malnutrition.

Local uses:

1. As a sponge bath in fevers.
2. As a rubefacient and counterirritant.

3. As a local anesthetic, injected in or near the nerves to allay pain, as in spasmodic facial neuralgia or sciatica.

4. As an antiseptic, applied externally in 70 percent strength.

Systemic uses:

1. In treatment of insomnia, in the form of whisky, brandy, or wine.
2. As a digestive stimulant.
3. As a hypnotic.

Toxicology.—Acute alcohol intoxication. The symptoms are stupor or coma, cold clammy skin, low body temperature, slow respiration, normal or dilated pupils, accelerated heart rate. Death is rare, unless coma persists for more than 12 hours.

Treatment

1. Gastric lavage.
2. Warmth.
3. Stimulants.
4. Symptomatic measures.

Toxicology.—Chronic alcoholism. The symptoms vary, including gastroenteritis, dilation of the skin capillaries, particularly those of the face, loss of weight, malnutrition, personality changes, delirium tremens, mental and moral deterioration, alcoholic cirrhosis, pellagra, and serious organic disorders.

The patient should be hospitalized for treatment.

Brandy.

Whisky.

Sherry Wine.

OPIUM AND ITS ALKALOIDS

Opium.—Opium (Gum Opium).

Action.—Morphine is the most important of the alkaloids of opium. It is a narcotic, depressing cerebral activity and producing analgesia and sleep. It is a respiratory depressant. Small doses dull the cough reflex and larger doses abolish it. It often relieves dyspnea. This drug stimulates the spinal cord and the medullary vomiting center and is therefore never used as a sedative in strychnine poisoning or other convulsive states. It constricts the pupils. It causes constipation by diminishing the secretions of the gastrointestinal tract and increasing the tone of the intestinal musculature to the point of spasm. Morphine stimulates other smooth muscles to contraction. It has little effect on the cardiovascular system, but therapeutic amounts of morphine relax the cutaneous blood vessels, causing flushing, itching, sweating, and sneezing.

Opium is less depressant to respiration than morphine because of the stimulating effect of narcotine and papaverine. It is more constipating than morphine, probably because of the depressant effect of papaverine on the smooth muscles of the intestines. It is more likely to cause nausea because of its irritant action on the gastric mucosa.

Uses of the opiates:

1. As analgesics. For this purpose, morphine is preferred to the whole drug.
2. As cough sedatives in bronchitis.
3. In the treatment of certain types of diarrhea, preparations of the whole drug being preferred to morphine.
4. As diaphoretics, usually in the form of Dover's powder.
5. To allay vomiting, especially of reflex origin.
6. As hypnotics.

Toxicology.—The symptoms are deep sleep or coma, depressed respiration, pupils symmetrical and contracted, cyanosis, suppressed urine, low body temperature, and cold, clammy skin. The blood pressure may fall to shock level. There may be skin rashes and pruritis. Before depression, the patient may become restless and delirious and vomiting may occur. Death is usually due to respiratory failure.

Treatment

1. Gastric lavage with potassium permanganate or iodine solution well diluted.
2. Magnesium sulfate solution should be left in the stomach after lavage to act as a cathartic.
3. Respiratory stimulants, such as caffeine, ephedrine, coramine, or atropine may be used.
4. Only one dose not to exceed 1.5 mg. of atropine should be administered.
5. The kidneys should be kept functioning as they are the main agent of elimination of the poison.
6. The patient should be kept awake and moving if possible.
7. Treated symptomatically.

Opium and morphine are extremely habit forming. This is one of the most difficult to overcome and produces serious effects on the physical and moral condition of its victims. Their sale is strictly regulated in the United States and most other countries.

Granulated Opium.—Dose: 60 mg. (1 grain).

Powdered Opium.—Dose: 60 mg. (1 grain).

Opium Tincture—(Laudanum).—Dose: 0.6 cc. (10 min.).

Camphorated Opium Tincture — (Paregoric).—Dose: 4.0 cc. (1 fluidrachm).

Opium Extract.—Dose: 30 mg. (½ grain).

Compound Opium and Glycyrrhiza Mixture—(Brown Mixture).—Dose: 4.0 cc. (1 fluidrachm).

Ipecac and Opium Powder—(Dover's Powder).—0.3 gm. (5 grains).

Morphine Sulfate—Morphinae Sulfas.—Dose: 10 mg. (⅙ grain).

Morphine Hydrochloride.—Dose: 8 mg. (⅛ grain).

Morphine Injection.—Dose of the morphine salt: 10 mg. (⅙ grain).

Morphine and Atropine Sulfates Tablets.—Dose: morphine sulfate, 15 mg. (¼ grain); atropine sulfate, 0.4 mg. (1/150 grain).

Morphine Sulfate Tablets.—Dose of morphine sulfate: 10 mg. (⅙ grain).

Codeine.—Codeine resembles morphine in action but has about one-sixth of the analgesic power and about one-fourth of the respiratory depressant effect of morphine. It has the same therapeutic uses. Dose: 30 mg. (½ grain).

Codeine Phosphate—Codeinae Phosphas.—Dose: 30 mg. (½ grain).

Codeine Phosphate Tablets.—Dose: 30 mg. (½ grain).

Codeine Sulfate—Codeinae Sulfas.—Dose: 30 mg. (½ grain).

Codeine Sulfate Tablets.—Dose 30 mg. (½ grain).

Ethylmorphine Hydrochloride—Aethylmorphinae Hydrochloridum (Dionin).—It is prepared synthetically from morphine. It has more analgesic and hypnotic power than codeine but less than morphine.

It is used as a cough sedative and analgesic, and as a lymphagogue in various inflammations of the eye and nose because of its irritating effect on the mucous memberane. Dose: 15 mg. (¼ grain).

Dihydromorphinone Hydrochloride—Dihydramorphinoni Hydrochloridum (Dilaudid).—The action is similar to that of morphine, but it is about 10 times more analgesic and five times more hypnotic. It causes less nausea, vomiting, and constipation than morphine. It is used as an analgesic and cough sedative. Dose: 2 mg. (1/30 grain).

Dihydromorphinone Hydrochloride Injection.—Dose: 2 mg. (1/30 grain).

Dihydromorphinone Hydrochloride Tablets.—Dose: 2 mg. (1/30 grain).

Meperidine Hydrochloride (Demerol Hydrochloride).—It is prepared synthetically. Chemically it is not related to the opium alkaloids. A white crystalline powder, soluble in water.

Action.—Is similar to a combination of morphine and atropine, although its action is milder than that of morphine. Dose: intramuscular, 0.1 gm. (1½ grain).

Meperidine Hydrochloride Injection.—Dose: 0.1 gm. (1½ grain).

Meperidine Hydrochloride Tablets.—Dose: 0.1 gm. (1½ grain).

ANTISPASMODICS

These relax smooth or skeletal muscle. They include curare and papaverine preparations.

Tubocurarine Chloride.

Action.—In small doses it blocks the nerve muscle transmission of nerve impulses to skeletal muscle. Larger doses depress ganglionic transmissions in the autonomic nervous system. It is used in a number of conditions to reduce the tone of contractile skeletal muscle.

Tubocurarine Chloride Injection.

Papaverine Hydrochloride.—Papaverinae Hydrochloridum.

Action.—Papaverine differs from other official opium alkaloids in that it produces very little effect on the central nervous system. In therapeutic doses it does not cause analgesia or sleep. It relaxes many smooth muscles, particularly those of the blood vessels, bronchi, gastrointestinal tract, ureter, and biliary system.

Papaverine is used in the treatment of peripheral or pulmonary arterial embolism, in threat-

ened gangrene, and in certain other forms of peripheral vascular disease. It is also used to relax spasms of the bronchi or the gastrointestinal and genitourinary tracts. Dose: oral or intravenous, 0.1 gm. ($1\frac{1}{2}$ grain).

Papaverine Hydrochloride Injection.—Dose: 0.1 gm. ($1\frac{1}{2}$ grain).

AUTONOMIC DRUGS

The autonomic nervous system, also called the vegetative, visceral, or involuntary nervous system, controls the automatic functions of the body. It consists of nerves, ganglia, and plexuses which innervate the heart, blood vessels, glands, viscera, and smooth muscles. It is divided into the sympathetic and parasympathetic nervous systems.

The sympathetic nerves, when stimulated, usually discharge as a unit, and the effects can be noticed under circumstances of fright or rage. The heart is accelerated, the blood pressure rises, the spleen discharges red cells into the blood, the blood sugar rises, and the pupils dilate. Hence the body is better prepared to fight.

The parasympathetic nerves do not all discharge at once. They are concerned with the functions of conservation and restoration rather than expenditure of energy. They slow the heart, lower the blood pressure, stimulate gastrointestinal movements and secretions, aid absorption, contract the pupil, and empty the bladder and rectum.

Chemical Mediation of Nerve Impulses.—The theory today is that nerve impulses effect responses in muscles and glands by liberating a chemical substance which acts as the major local exciting agent. Upon stimulation, the parasympathetic nerves release at their peripheral endings a chemical called acetylcholine. This substance is probably present in the tissues in a physiologically inactive form, and the nerve impulses change it to an active state in which it can be destroyed by cholinesterase. Cholinesterase is an enzyme, present in blood and tissues, which splits acetylcholine into choline, a physiologically weak substance, and acetic acid. The cholinesterase appears to act as a check on the action of the acetylcholine. It is usually present in tissues where acetylcholine is liberated by nerve impulses.

Upon stimulation of the sympathetic nerves, a substance similar to epinephrine, called sympathin, is liberated. It exists in two forms, sympathin E, and excitor, and sympathin I, an inhibitor.

The parasympathetic nerves are sometimes referred to as the cholinergic nerves and the sympathetic nerves as the adrenergic nerves.

The autonomic drugs are drugs which act on structures innervated by the autonomic nerves, either stimulating or depressing the effector cells. They do not affect the nerve endings, so they cannot be called autonomic nerve depressants or stimulants. They will be discussed under various groups.

PARASYMPATHOMIMETIC DRUGS

These are drugs which stimulate the structures which are innervated by the parasympathetic nerves and produce effects similar to those produced by stimulation of the nerves.

CHOLINE ESTERS

Acetylcholine.—This is not an official drug, but it will be discussed here because of its relationship to the other choline esters.

Action.—In therapeutic doses it produces little change in cardiovascular activity except for a vasodilation and slight fall in blood pressure. Large doses given intravenously may cause flushing and warmth of the skin, throbbing in the head, palpitation, bounding pulse, and profuse sweating. Large doses increase peristalsis and the gastrointestinal secretions. Glands innervated by the cholinergic nerves, particularly the salivary, lacrimal, and sweat glands, are stimulated by acetylcholine. It also causes bronchoconstriction and increased secretion of the bronchial glands.

Methacholine Chloride.—Methacholinae Chloridum (Mecholyl, Mecholyn, Acetyl-beta-methylcholine Chloride).

Action.—Methacholine is similar in action to acetylcholine, but it is less rapidly inactivated by cholinesterase and shows a selective action for certain effector cells. It is about 200 times as potent as acetylcholine in producing cardiac responses. It is used in the treatment of auricular paroxysmal tachycardia and of abdominal disten-

tion due to postoperative intestinal ileus, anesthesia, acute infectious diseases, and sometimes in urinary retention. It is used orally in treatment of atonic constipation. Methacholine is a physiological antidote in atropine poisoning. It is effective for the relief of vasospasm and pain in peripheral vascular disease and in the treatment of indolent and gangrenous ulcers due to this disease. Dose: oral, 0.2 gm. (3 grains); subcutaneous, 10 mg. (1/6 grain).

Methacholine Chloride Capsules.—Dose of methacholine chloride; 0.2 gm. (3 grains).

Methacholine Chloride Injection.—Dose of methacholine chloride, subcutaneous, 10 mg. (1/6 grain).

Carbachol.—Carbarcholum (Carbamylcholine Chloride).

Action.—Carbachol differs from methacholine in that it is not destroyed by cholinesterase; it has greater action on the gastrointestinal tract and urinary bladder but less on the heart. It is the most potent and toxic of the known derivatives of choline. Atropine is less effective in antagonizing its action than that of methacholine and acetylcholine.

It is used to relieve urinary retention following labor, accompanying certain types of spinal lesion, or in postoperative cases, and in the treatment of abdominal distention due to postoperative intestinal ileus. It is also used in the treatment of auricular paroxysmal tachycardia and for the relief of acute pain due to vasospasm in peripheral vascular disease. Dose: oral, 2 mg. (1/30 grain); subcutaneous, 0.25 mg. (1/250 grain).

Carbachol Injection.—Dose of carbachol: subcutaneous, 0.25 gm. (1/250 grain).

Carbachol Tablets.—Dose of carbachol: 2 mg. (1/30 grain).

Pilocarpine Nitrate.—Pilocarpinae Nitras.

Action.—Pilocarpine stimulates the smooth muscle and gland cells innervated by cholinergic nerves, especially the sweat and salivary glands. It also produces myosis and such other effects as stimulation of the smooth muscles of the intestinal tract, increase in tone and motility of the ureters, urinary bladder, gallbladder, and biliary ducts, and constriction of the bronchioles, which are undesirable and not therapeutically important, although they have some toxicologic importance.

It is used as a myotic in the treatment of glaucoma and other eye diseases, after mydriasis, occasionally as a diaphoretic in the treatment of edema, and as a sialogogue. It is sometimes incorporated in cough mixture as an expectorant. It is a physiological antidote in atropine poisoning. Dose: 5 mg. (1/12 grain).

Toxicology.—The symptoms appear quickly after ingestion of the drug and soon reach their peak. The first to be noted are intestinal disturbances, violent peristalsis, colic, and persistent purging. There is nausea and vomiting, fibrillary twitching of the muscles all over the body, contraction of the pupils to pin-point size, blurred vision, marked sweating, salivation, lacrimation, dyspnea, increased pulmonary secretions, urinary urgency, difficulty in voiding, pale skin bathed in cold perspiration, rapid cardiac rate, weak pulse, and blood pressure at shock level. Death may be due to pulmonary or central respiratory paralysis.

Treatment

1. Atropine sulfate hypodermically or intravenously as the physiological antidote.
2. Followed by symptomatic treatment.

Pilocarpine Hydrochloride.

INHIBITORS OF CHOLINESTERASE

Physostigmine Salicylate. — Physostigminae Salicylas, (Eserine Salicylate).

Action.—Physostigmine acts by inhibiting cholinesterase from inactivating acetylcholine, permitting the acetylcholine to exert all its characteristic actions in an intensified manner. Its more important therapeutic effects are on the pupil of the eye and the intestinal and skeletal muscles. Other responses are of toxicologic interest. It is used as a myotic, particularly in the treatment of glaucoma and after mydriasis. It is also employed in the treatment of abdominal distention due to postoperative intestinal ileus. It is a depressant to the motor side of the spinal cord and is therefore used as a physiological antidote in strychine poisoning. Dose: 2 mg. (1/30 grain).

Toxicology.—Symptoms and treatment are the same as for poisoning by pilocarpine.

Neostigmine Bromide.—Neostigminae Bromidum (Prostigmine Bromide).

Action.—Neostigmine acts like physostigmine by inhibiting cholinesterase. It is used like physostigmine for the relief of abdominal distention and in treatment of atony of the urinary bladder. It does not produce myosis, fall in blood pressure, uneven pulse, or bronchiospasm. Dose: 15 mg. (1/4 grain).

Neostigmine Bromide Tablets.—Dose of neostigmine bromide: 15 mg. (1/4 grain).

Neostigmine Methylsulfate — Neostigminae Methylsulfas (Prostigmine Methylsulfate).—It is used for the same purposes as neostigmine bromide, but it is administered parenterally. Dose: subcutaneous or intramuscular, 0.5 mg. (1/120 grain).

Neostigmine Methylsulfate Injection.—Dose of neostigmine methylsulfate: Subcutaneous or intramuscular, 0.5 mg. (1/120 grain).

SYMPATHOMIMETIC DRUGS

These drugs stimulate the structures innervated by the sympathetic or adrenergic nerves, producing an effect similar to that caused by stimulation of the adrenergic nerves.

Epinephrine.—Epinephrine (Adrenalin, Suprarenalin).—Epinephrine is usually employed in the form of hydrochloride in solution.

Action.—Its most important actions are on the heart and blood vessels. It accelerates the heart rate, increases the cardiac output, and alters the cardiac rhythm. It constricts the blood vessels in some areas and dilates them in others. The vessels of the skin and mucosa are constricted after local application or injection of the drug, while those of the skeletal muscles are dilated by injection. An intravenous injection produces an almost immediate rise in blood pressure. Epinephrine is not a respiratory stimulant. It is a metabolic stimulant and tends to increase the basal metabolism rate. It relaxes the bronchial musculature and the muscles of the gastrointestinal tract and urinary bladder. Applied locally to the eye, it has a mydriatic effect on some patients.

Epinephrine is used to control hemorrhage from minor cuts, but it is not effective if a vein or artery is involved. It relieves nasal congestion by vasoconstriction, but this effect is of short duration. It is used in conjunction with local anesthetics to prolong their action and lessen the possibility of hemorrhage and is given during spinal anesthesia to maintain blood pressure. It is valuable in the treatment of acute cardiac failure and in the resuscitation of cardiac arrest. It is often used in the treatment of bronchial asthma, in the form of the injection or inhalation. It is also employed for the relief of certain allergic disorders such as hives, urticaria, serum reactions, and hay fever. Dose: subcutaneous or intramuscular, 1 mg. (1/60 grain).

Ephinephrine Inhalation.—(Epinephrine Solution, 1:100).

Epinephrine Injection—(Epinephrine Hydrochloride Injection).—Dose of epinephrine: subcutaneous or intramuscular, 1 mg. (1/160 grain).

Epinephrine Solution.—Epinephrine Solution, 1:1,000).

Epinephrine in Oil Injection.—Dose: 2 mg. (1/30 grain).

Epinephrine Bitartrate.

Epinephrine Bitartrate Ophthalmic Ointment.—1 percent.

Epinephrine Bitartrate Opthalmic Solution.—2 percent.

Phenylephrine Hydrochloride.—(Neo-Synephrine Hydrochloride).

Action.—It has a vasopressor action when injected or taken orally. When applied locally to mucous membrane, it acts as a vasoconstrictor and reduces swelling and congestion. It is often combined with local anesthetics in much the same way as epinephrine hydrochloride.

Phenylephrine Hydrochloride Injection.

Phenylephrine Hydrochloride Solution.

Ephedrine.—Ephedrina.

Action.—Ephedrine is similar in action to epinephrine but differs from it in many ways. It is more stable and can be given by mouth, and its action lasts longer. It stimulates the central nervous system and respiration. Its constrictor effects are less marked, but it does not produce any after-congestion. However, if used too often it may lose its effectiveness. It has a better mydriatic effect than epinephrine.

Ephedrine is used in the form of spray or nose drops for the relief of nasal congestion and bronchial asthma. It is effective in the treatment of

certain allergic disorders, such as hay fever or hives. It is given with spinal anesthesia to maintain blood pressure. It is used as a mydriatic in ophthalmology because it has no cycloplegic effect. It is occasionally employed to allay motion sickness and in the treatment of narcolepsy.

Ephedrine Hydrochloride.—Dose: 25 mg. (3/8 grain).

Ephedrine Hydrochloride Capsules.—Dose: 25 mg. (3/8 grain).

Ephedrine Hydrochloride Tablets.—Dose: 25 mg. (3/8 grain).

Ephedrine Sulfate.—Dose: 25 mg. (3/8 grain).

Ephedrine Sulfate Capsules.—Dose: 25 mg. (3/8 grain).

Ephedrine Sulfate Tablets.—Dose: 25 mg. (3/8 grain).

Ephedrine Sulfate and Phenobarbital Capsules.—Dose: 25 mg. (3/8 grain) of ephedrine sulfate; 30 mg. (1/2 grain) of phenobarbital.

Ephedrine Sulfate Jelly.—1 percent.

Ephedrine Sulfate Solution.—3 percent.

Ephedrine Sulfate Injection.—Dose: 25 mg. (3/8 grain).

Ephedrine Sulfate Syrup.—Dose: 4 cc. (1 fluidrachm).

Ephedrine Spray.—1 percent.

Compound Ephedrine Spray.—1 percent.

Racephedrine Hydrochloride.—Dose: 25 mg. 3/8 grain).

Racephedrine Hydrochloride Capsules.—Dose: 25 mg. (3/8 grain).

Racephedrine Hydrochloride Solution.—1 percent.

Amphetamine.—(Racemic Amphetamine).

Action.—Amphetamine produces local effects similar to ephedrine. On inhalation there is shrinking of the nasal mucosa. It is used in head colds, sinusitis, hay fever, and asthma. Its use is contraindicated in cases of cardiovascular disease.

Amphetamine Inhalant.—This is an inhaler containing aromatic amphetamine.

Ametamine Sulfate.

Action.—Amphetamine sulfate is a central nervous system stimulant, tending to abolish fatigue and mental depression. Its effects on the higher nerve centers is so pronounced that it is rarely used for any other action. It is used in the treatment of narcolepsy, mental depression, treatment of alcoholism, and as an appetite depressant in control of obesity.

Toxicology.—Amphetamine Sulfate may, in certain instances, produce overstimulation, restlessness, sleeplessness, gastrointestinal disturbance, chills, and collapse. Caution should be exercised in administering this drug to patients suffering from hypertension or cardiovascular disease. Dose: 5 mg. (1/12 grain).

Amphetamine Sulfate Tablets—(Benzedrine Sulfate Tablets).—Dose: 5 mg. (1/12 grain).

Methamphetamine Hydrochloride.—(Desoxyephedrine).

Action.—Similar to amphetamine sulfate in uses. It is believed to be more powerful as a stimulant but less active on the cardiovascular system. Dose: 5 mg. (1/12 grain).

HISTAMINE ANTAGONIZING AGENTS

Histamine has been demonstrated to have an important role in allergenic reactions. This fact has led to the development of compounds that oppose it.

Diphenhydramine Hydrochloride.

Action.—It has the ability to antagonize the pharmacologic effects of histamine. It reduces the bronchoconstriction produced by histamine. It is used in the symptomatic treatment of urticaria, allergic rhinitis, serum reactions, and other allergic conditions. It will sometimes relieve the itching of infantile eczema. The principal side reaction is the production of sleep. Dose: 50 mg. (3/4 grain).

Diphenhydramine Hydrochloride Capsules—(Benadryl).—Dose: 50 mg. (3/4 grain).

Tripelennamine Hydrochloride. — A white crystalline powder. The incidence of side reactions is low. Dose: 50 mg. (3/4 grain).

Tripelennamine Hydrochloride Tablets —(Pyribenzamine).—Dose: 50 mg. (3/4 grain).

AUTONOMIC BLOCKING AGENTS

These drugs block many of the responses to cholinergic or adrenergic nerve stimulation by inhibiting the effector cells.

CHOLINERGIC NERVE BLOCKING AGENTS

Atropine.—(Atropina).

Action.—Atropine has two major actions:

1. On the central nervous system. It stimulates the medulla and higher centers and causes an increase in respiration.

2. On the smooth muscles and the secretory glands. It relaxes the muscles of the intestinal tract, bronchi, ureter, biliary ducts, and gallbladder. It inhibits glandular secretions, causing dryness of the nose, throat, bronchi, mouth, and skin.

Atropine has a mydriatic effect on the pupil of the eye and also causes a paralysis of accommodation. Large doses increase the cardiac rate. It causes dilation of the cutaneous blood vessels, producing a scarlet flush. It may also cause a slight rise in body temperature. It has a dulling effect on the sensory nerve endings and is often used as an anodyne.

Atropine is used as a mydriatic and cycloplegic in ophthalmology, as a anhidrotic, in large doses as a circulatory stimulant, and as a respiratory stimulant in certain poisonings. It is a physiological antidote for eserine, prostigmine, pilocarpine, and muscarine. It is used to relax spasms of the intestinal tract and also those of the bronchi in bronchial asthma. It is given with morphine to overcome its respiratory depressant effects. Dose: 0.4 mg. ($\frac{1}{150}$ grain).

Toxicology.—Symptoms are warmth and dryness of the mouth, difficulty in swallowing and talking, mydriasis, blurred vision, intolerance of light, hot dry skin, a rash resembling that of scarlet fever on face, neck, and upper body, a rise in body temperature, rapid cardiac rate, weak pulse, elevated blood pressure, giddiness, muscular incoordination, confusion, often hallucinations, delirium, or mania. These symptoms may persist for several hours. Death is due to respiratory failure.

Treatment

1. Gastric lavage with a chemical antidote, pilocarpine as a physiological antidote.

2. Symptomatic treatment.

Atropine Sulfate.—Dose: 0.5 mg. ($\frac{1}{120}$ grain).

Atropine Sulfate Tablets.—Dose: 0.5 mg. ($\frac{1}{120}$ grain).

Scopolamine Hydrobromide. — Scopolaminae Hydrobromidum (Hyoscine Hydrobromide).

Action.—Scopolamine differs from atropine in its action on the central nervous system. Atropine may first stimulate and then depress the brain, but scopolamine is primarily a depressant, and therapeutic doses will cause drowsiness, fatigue, and sleep. Its actions on the eye, heart, intestines, and bronchi are similar to those of atropine but more pronounced and prolonged. It has a stimulating effect on respiration.

It is used as a sedative in delirium tremens, maniacal states, cardiac and hyperthyroid psychoses, and to quiet nervous unrest, particularly in the withdrawal treatment of opium and alcohol. It is useful in ophthalmology as a mydriatic of short duration. It is frequently used with morphine as a respiratory stimulant. Dose: 0.6 mg. ($\frac{1}{100}$ grain).

Toxicology.—The symptoms and treatment are the same as in atropine poisoning.

Scopolamine Hydrobromide Tablets.—Dose: 0.6 mg. ($\frac{1}{100}$ grain).

Homatropine Hydrobromide—Homatropinae Hydrobromidum.—A white crystalline powder, affected by light, soluble in 6 parts water and 40 parts alcohol. It is a synthetic alkaloid.

Homatropine is less active and toxic than atropine. Its only use is in ophthalmology as a mydriatic, in 1 or 2 percent solution. It is preferable to atropine because its effect is of short duration.

Homatropine Methylbromide.—Dose: 2.5 mg. ($\frac{1}{25}$ grain).

Homatropine Methlybromide Tablets.—Dose: 2.5 mg. ($\frac{1}{25}$ grain).

Eucatropine Hydrochloride. — Eucatropinae Hydrochloridum (Euphthalmine).

Action.—It is used solely as a mydriatic in 5 or 10 percent solution. Its effect is rapid and of short duration. Maximum dilation occurs in 30 minutes and the effects disappear in about 3 hours. It causes no loss of accommodation. It has other peripheral actions similar to those of atropine but weaker.

Belladonna Leaf. — Belladonnae Folium (Deadly Nightshade Leaf).—The activity of the

drug resides in the tropine, and its therapeutic uses are the same as those of the alkaloid.

Belladonna Extract.—Dose: 15 mg. (1/4 grain).

Belladonna Ointment.—10 percent Belladonna Extract.

Belladonna Tincture.—Dose: 0.6 cc. (10 min.).

Belladonna Leaf Fluidextract.—Dose: 0.06 cc. (1 min.).

Belladonna Root.—Belladonnae Radix (Deadly Nightshade Root).—The alkaloids are the same as those of the leaf, and the action and uses are the same.

Belladonna Root Fluidextract.—Dose: 0.05 cc. (3/4 min.).

Belladonna Plaster.

Belladonna Liniment.

Hyoscyamus—Hyoscyamus (Henbane).—Hyoscyamus resembles belladonna in action and uses. However, the presence of a larger proportion of scopolamine makes it a central depressant. Its important use is in the relief of painful spasms of the unstriated muscle, as in irritable bladder. Dose: 0.2 gm. (3 grains).

Hyoscyamus Tincture.—Dose: 2 cc. (30 min.).

Hyoscyamus Extract.—Dose: 50 mg. (3/4 grain).

Hyoscyamus Fluidextract.—Dose: 0.2 cc. (3 min.).

Stramonium—Stramonium (Jimson Weed, Jamestown Weed).—Stramonium yields about 0.25 percent alkaloids, the most important of which are atropine, hyoscyamine, and scopalmine. It is similar in action to belladonna and is occasionally employed in its place. It is more frequently used in treatment of asthma, usually by smoking the leaves.

Stramonium Extract.—Dose: 20 mg. (1/3 grain).

Stramonium Tincture.—Dose: 0.75 cc. (12 min.).

Stramonium Capsules.—Dose: 75 mg. (1 1/4 grains) of stramonium.

Stramonium Fluidextract.—Dose: 0.075 cc. (1 1/4 min.).

ADRENERGIC NERVE BLOCKING AGENTS

Ergotamine Tartrate.—Ergotaminae Tartras (Gynergen).

Action.—Ergotamine specifically blocks the effects of stimulation of adrenergic nerves. It also prevents response to epinephrine stimulation. It does not prevent the release of the chemical mediator or the formation of sympathin E and I. In therapeutic doses it has only a slight and irregular blocking effect. Large doses cause vasoconstriction and increase in blood pressure. Ergotamine has a variable action on the central nervous system. Small doses increase respiration.

Ergotamine Tartrate is a valuable drug for relieving migraine headache. It increases the motor activity of the uterus but is less efficient than ergonovine and is seldom used as a uterine stimulant. Dose: intramuscular, 0.5 mg. (1/120 grain); oral, 1 mg. (1/60 grain).

Toxicology.—This will be discussed under ergot.

Ergotamine Tartrate Tablets.—Dose: 1 mg. (1/60 grain).

Ergotamine Tartrate Injection.—Dose: 0.5 mg. (1/120 grain).

OXYTOCICS

Oxytocics or ecbolics are drugs which produce a rhythmic contraction of the uterus. Their action is selective for the uterus, although other smooth muscles are affected. The most important oxytocics are the alkaloids of ergot, ergonovine and ergotamine; oxytocin, the oxytocic principle extracted from posterior pituitary; and quinine.

Ergot.—Ergota (Rye Ergot, Rye Smut).

Action.—The active principles are ergotamine, ergotoxine, and ergonovine. Ergotamine and ergotoxine are similar in their pharmacological actions. They have a stimulating effect on the uterus. They increase the blood pressure by constriction of the smaller blood vessels and may damage the capillary endothelium, causing vascular stasis, thrombosis, and gangrene. They also slow the heart. Ergonovine also stimulates the uterus, but its action is more rapid. The response after intravenous injection is almost immediate, and after oral administration it takes place in a few minutes. For this reason it is preferred as an oxytocic. Ergonovine is readily absorbed from the intestinal tract.

Ergot is undependable in action and subject to deterioration, so its clinical use has decreased since the discovery of ergonovine.

Toxicology.—In acute poisoning, the symptoms consist of paleness and coldness of the skin, partial paralysis with numbness and tingling sensation of limbs, feeble pulse, and possible abortion in pregnancy. In chronic poisoning, which may occur by ingestion of rye infected with ergot, the symptoms are gangrene in the extremities, increased rapidity or slowing of heart action, high or low blood pressure, headache, nausea, vomiting, diarrhea, and sometimes blindness. The treatment is symptomatic.

Ergot Extract.—Dose: 0.5 gm. (7½ grains).

Ergot Fluidextract.—Dose: 2 cc. (30 min.).

Prepared Ergot.—Dose: 1.5 gm. (22 grains).

Ergonovine Maleate.—Ergonovinae Maleas (Ergometrine Maleate, Ergotrate).—It is used as an oxytocic. Dose: intravenous or intramuscular, 0.2 mg. (1/300 grain); oral, 0.5 mg. (1/120 grain).

Ergonovine Maleate Injection.—Dose: 0.2 mg. (1/300 grain).

Ergonovine Maleate Tablets.—Dose: 0.5 mg. (1/120 grain).

ANALGESICS AND ANTIPYRETICS

Analgesics are drugs which are used to relieve pain without producing loss of consciousness. Some drugs of this general class were first used as antipyretics and are sometimes called antipyretic analgesics.

SALICYLATES

Action.—The salicylates are antipyretics and analgesics. They lower the temperature rapidly in febrile patients but rarely affect normal body temperature. This is true of most antipyretics. As analgesics the salicylates are less effective than morphine. Therapeutic doses have no important cardiovascular action. Large doses may relax the smooth muscles, particularly the peripheral blood vessels. Toxic doses may depress circulation by vasomotor paralysis. The heart is not affected except in very large doses. Salicylates may irritate the gastrointestinal tract and cause epigastric distress, nausea, and vomiting. Therapeutic doses increase the urinary excretion of uric acid.

Salicylates relieve pain in headache, myalgia, arthralgia, and similar conditions. In acute rheumatic fever and gout they reduce the pain, immobility, swelling, and inflammation of the joints.

Toxicology.—The symptoms of mild salicylate poisoning, sometimes called salicylism, are headache, visual and auditory disturbances, dizziness, sweating, thirst, gastrointestinal disturbances, and sometimes skin rashes with excessive itching. Large doses may cause dyspnea. As the poisoning progresses, cardiovascular collapse and respiratory failure may ensue. The treatment is symptomatic. Some patients have an idiosyncrasy to salicylates, usually manifested by skin rashes.

Salicylic Acid—Acideum Salicylicum, $C_6H_4.OH.COOH$ (Orthohydroxybenzoic acid).—Salicylic acid is too irritating to be taken internally. It is used locally for the removal of corns and warts and in the treatment of skin diseases like "athlete's foot" and eczema. It is prescribed in the form of lotion, collodion, ointment, and dusting powder.

Benzoic and Salicylic Acid Ointment—(Whitfield's ointment).—12 percent benzoic acid, 6 percent salicylic acid.

Salicylic Collodion.—10 percent.

Salicylic Acid Plaster—Emplastrum Acidi Salicylici.—This plaster is used for keratoplastic effect of salicylic acid on hardened, keratinized epidermal tissue.

Sodium Salicylate—Sodii Salicylas, $C_6H_4.OH.COONa$.—The uses are those described under salicylates. Dose: 1 gm. (15 grains).

Sodium Salicylate and Iodine Injection.—Dose: 1 gm. (15 grains).

Sodium Salicylate and Iodide with Colchicine Injection.

Sodium Salicylate Elixir.—Dose: 4.0 cc. (1 fluidrachm).

Sodium Salicylate Injection.—Dose: 1 gm. (15 grains).

Sodium Salicylate Tablets.—Dose: 1 gm. (15 grains).

Ammonium Salicylate—Ammonnii Salicylas, $C_6H_4.OH.COONH_4$.—Dose: 1 gm. (15 grains).

Strontium Salicylate—Strontii Salicylas.—Dose: 1 gm. (15 grains).

Acetylsalicylic Acid—Acidum Acetylsalicylicum (aspirin).—The uses are the same as men-

tioned under salicylates. It is sometimes used as a gargle for sore throat. Dose: 0.3 gm. (5 grains).

Acetylsalicylic acid tablets.—Dose: 0.3 gm. (5 grains).

Acetylsalicylic Acid Capsules.—Dose: 0.3 gm. (5 grains).

Methyl Salicylate—Methylis Salicylas (Oil Wintergreen).—It is used locally as a counter-irritant for relief of pain in the muscles and is prepared in the form of ointments or liniments. It is never taken internally as it causes gastric irritation.

Phenyl Salicylate.—Phenylis Salicylas, $C_6H_4.OH.COO.C_6H_5$ (Salol)—**Action.**—It is used as an intestinal antiseptic, being hydrolyzed in the duodenum into phenol and salicylic acid. It is also used as an enteric coating for capsules and pills. Overdoses may cause symptoms of phenol poisoning. Dose: 0.3 gm. (5 grains).

Phenyl Salicylate Tablets.—Dose: 0.3 gm. (5 grains).

MISCELLANEOUS ANALGESICS

Cinchophen.—Cinchophenum (Phenylcinchoninic Acid, Atophan)—**Action.**—Cinchophen resembles the salicylates in its pharmacological actions. It is used as an analgesic, antipyretic, antirheumatic, and in treatment of gout. Excessive use injures the liver, causing hepatitis and cirrhosis. Its toxic effects are unpredictable. Most authorities agree that there is no safe way to administer Cinchopen. Dose: 0.5 gm. (7½ grains).

Cinchophen Tablets.—Dose: 0.5 gm. (7½ grains).

Neocinchophen—Neocinchophenum.—Neocinchophen resembles cinchophen in actions and uses but is less irritating to the stomach. Dose: 0.3 gm. (5 grains).

Neocinchophen Tablets.—Dose: 0.3 gm. (5 grains).

Colchicine—Colchicina.—Colchicine is used in treatment of gout. In some cases the pain, swelling, and redness are relieved in a few hours, but many patients do not respond. Dose: 0.5 mg. (1/120 grain).

Toxicology.—The symptoms of poisoning are excessive nausea, vomiting, abdominal pains, purging, straining, thirst, weak pulse, cold extremities, general prostration, headache, delirium, stupor muscular depression, and bloody urine.

Treatment

Gastric lavage.

Symptomatic therapy.

Colchicine Tablets.—Dose: 0.5 mg. (1/120 grain).

Strong Colchicum Corm Tincture.—Dose: 0.6 cc. (10 min.).

Colchicum Corm Fluidextract.—Dose: 0.25 cc. (4 min.).

Colchicum Seed Fluidextract.—Dose: 0.2 cc. (3 min.).

Colchicum Seed Tincture.—Dose: 2 cc. (30 min.).

COAL TAR ANALGESICS

The two classes studied will be the para-aminophenol derivatives, as acetanilid and acetophenetidin, and the pyraxolon derivatives, as antipyrine and aminopyrine.

Both groups resemble the salicylates in action but differ from them in chemical structure. The para-aminophenol group are derivatives of aniline. In the body they are changed to para-aminophenol and exert their characteristic action.

Toxicology.—Para-aminophenol group. The most outstanding characteristic of acetanilid poisoning is cyanosis. Phenacetin causes this symptom less frequently. Other symptoms are difficulty in breathing, vertigo, weakness, and anginal pain. More severe cases are marked by subnormal temperature; shallow, rapid respiration; rapid, weak, irregular pulse; vasodilation and vascular collapse, followed by shock; circulatory failure. In some cases skin rashes appear, accompanied by fever. The central nervous system may be stimulated, producing excitement and delirium.

Treatment

1. Gastric lavage, followed by symptomatic treatment, such as artificial respiration.
2. Blood transfusion.
3. Shock treatment.

These drugs have a cumulative effect and are capable of causing chronic poisoning. Diagnosis is difficult and can be confirmed only by the patient's statement as to their use. Symptoms are

loss of weight, lack of appetite, digestive disturbances, insomnia, anemia, and cyanosis. The treatment consists of withdrawal of the drug and symptomatic treatment.

Toxicology.—Pyrozalin group. The symptoms are similar to those of acetanilid poisoning, except that cyanosis seldom occurs. Aminopyrine may cause leukopenia. The treatment is the same as for the para-aminophenol group.

Acetanilid — Acetanilidum (Antifebrin). — Dose: 0.2 gm. (3 grains).

Acetanilid Tablets.—Dose: 0.2 gm. (3 grains).

Acetophenetidin Tablets.—Dose: 0.3 gm. (5 grains).

Antipyrine—Antipyrina (Phenazone).—In addition to being an analgesic, antipyrine has some anesthetic and vasoconstricting properties and is occasionally used in nose sprays. Dose: 0.3 gm. (5 grains).

Aminopyrine — Aminopyrina (Amidopyrine, Pyramidon).—Aminopyrine is classified as a dangerous drug and its sale except on prescription is prohibited by law. Dose: 0.3 gm. (5 grains).

Aminopyrine Tablets.—Dose: 0.3 gm. (5 grains).

Aminopyrine Elixir.—Dose: 4.0 cc. (1 fluidrachm).

GENERAL ANESTHETICS

General anesthesia is loss of sensation affecting the whole body. It is essential when complete unconsciousness and adequate muscular relaxation are desired, when movement of the patient may imperil the success of the operation, in lengthy operations, and in those where spinal anesthesia is not safe, as in thoracic surgery. The anesthetics which are administered by inhalation have the safety factor of being eliminated from the blood very rapidly. Being volatile, they are excreted quickly by the lungs.

Action.—The loss of sensation appears to be due to an effect on the spinal cord and appears before complete loss of consciousness. In sufficient doses, the anesthetics eventually paralyze the spinal cord, the cerebrum, the vital centers in the medulla, usually affecting first the respiratory and later the vasomotor mechanism.

The stages of anesthesia are:

1. **Analgesia,** in which the patient experiences a feeling of warmth all over his body, possible suffocation, local irritation of the eyes, sensation gradually becoming dulled and abnormal. Analgesia gradually ensues and pain is abolished. The skin of the face and neck is flushed. The pupils dilate as the patient passes into the second stage.

2. **Delirium or Excitement,** accompanied by marked involuntary motor activity. The pulse is accelerated, respiration hurried and often irregular, the skin flushed, warm, and moist. The pupils may be somewhat dilated but contract readily to light.

3. **Surgical Anesthesia,** in which there is a complete loss of sensation, with unconsciousness. The patient is in a deep stupor from which he cannot be aroused. Most of the reflexes are abolished, although certain ones, as the conjunctival and respiratory, may be retained. The muscles are relaxed but keep their tone. Respiration is full and regular. The pulse is usually full and blood pressure normal, but it starts to fall as the fourth stage approaches.

4. **Medullary Paralysis,** the stage of collapse and danger. The relaxation becomes more complete and there is often a loss of muscular tone, giving rise to danger signals such as stertorous respiration and changes in facial expression. The pulse is rapid and feeble, respirations shallow and far apart, the skin livid or pale, often a peculiar cyanotic pallor, the pupils widely dilated. All reflexes lost. Death may be due to respiratory failure, as with ether, or to cardiac failure, as with chloroform.

Ether.—Aether, $C_2H_5.O.C_2H_5$ (Ethyl ether).

Action.—Ether is a very popular anesthetic, although it has certain undesirable features, particularly its slowness of action and postoperative effect. It is a comparatively safe anesthetic. There is some respiratory depression in the third stage but not a dangerous amount. Its depression of circulation is negligible compared with that of many other anesthetics.

Besides being a general anesthetic, ether is sometimes used in the form of the spirit as a carminative and remedy for hiccoughs.

Ether Spirit—(Hoffmann's Drops).—Dose: 4.0 cc. (1 fluidrachm).

Compound Ether Spirit—(Hoffmann's Anodyne).—Dose: 4.0 cc. (1 fluidrachm).

Chloroform — Chloroformum, $CHCl_3$ (Trichloromethane).—It is not flammable, but its heated vapor burns with a green flame. It is soluble in 210 parts water and miscible with alcohol and ether in all proportions. **Caution.**—Care should be taken not to vaporize chloroform near a naked flame because of the production of noxious gases.

Action.—As an anesthetic chloroform is much less disagreeable than ether, but in most cases it is decidedly more dangerous. It is more depressant to the heart and respiration, more harmful to the liver, and more irritating to the skin and mucous membranes, although it is less irritating to the respiratory tract. Since chloroform is less volatile than ether, it is used mostly in the warmer climates. It is more powerful than ether, requiring only one-eighth the amount of ether to produce anesthesia.

Chloroform is a powerful motor depressant in certain convulsions, such as those of strychnine poisoning. It is used internally as a carminative and occasionally as a sedative in cough mixtures. Externally it is used as a counterirritant in the form of a liniment.

Chloroform Liniment.

Chloroform Spirit.—Dose: 2.0 cc. (30 min.).

Chloroform Water.—Dose: 15 cc. (4 fluidrachms).

Cyclopropane—Cyclopropanum $(CH_2)_3$, (Trimethylene)—**Caution.**—Cyclopropane is flammable and its mixtures with oxygen or air explode when ignited.

Action.—Cyclopropane was introduced in 1930 as a safe and potent anesthetic. Induction with this gas is pleasanter than with ether. There is no respiratory irritation and laryngospasm, and no respiratory depression with deep surgical anesthesia. Blood pressure is little affected with anesthetic concentrations. The cardiac rate may be slowed during the surgical stage. Muscular relaxation is usually quite sufficient. Administered expertly, cyclopropane can be used safely in almost every type of operation, including obstetrical surgery. Its use allows adequate oxygen throughout all depths of anesthesia, and there is a wide margin of safety between anesthetic and toxic concentrations. Because it is highly flammable, caution must be observed in the use of the cautery or electric knife.

Vinyl Ether—Aether Vinylicus (Divinyl Oxide, Vinethene).—Vinyl ether acts quickly and recovery is correspondingly rapid. It is used for anesthesia of short duration.

Ethyl Chloride—Aethylis Chloridum.—It is very flammable and must not be used near a flame.

Ethyl chloride was originally used to produce local anesthesia by freezing because of the rapidity with which it evaporates from the skin. This form of anesthesia has several disadvantages. Dissection of frozen tissue is difficult, the process of thawing is painful, and freezing injures cells, lowers resistance to infection, and delays healing.

As a general anesthetic, ethyl chloride is used only for minor operations of short duration because of the rapidity of its action.

BASAL ANESTHETICS

Basal anesthesia is used as a basis for further and deeper anesthesia. It is produced by giving preanesthetic medication. It permits the patient to be brought to the operating room in an unconscious state but not sufficiently depressed for surgery.

Tribromoethanol — Triobromoethanol, $Br_3C.CH_2OH$ (Tribromethyl Alcohol, Avertin).

Action.—Tribromoethanol has a depressant action on the central nervous system similar to that of chloroform. The patient often falls asleep in 5 to 15 minutes, and the maximum effect takes place in from 20 to 30 minutes. At the end of an hour the anesthesia becomes lighter and consciousness is regained in about 2 or 3 hours. Postanesthetic recovery is usually pleasant.

Tribromoethanol is administered rectally and can be given to apprehensive patients without their knowledge. The official tribromoethanol solution is the form used. In proper doses it rarely causes serious respiratory effects. Dose: rectal, for each kilogram of body weight, 60 mg. (1 grain). The total amount administered should not exceed 8 gm. for women or 10 gm. for men, regardless of body weight.

Tribromoethanol Solution—(Bromethol).—Dose: rectal, for each kilogram of body weight,

0.06 cc. (1 min.), not to exceed 8 cc. for women and 10 cc. for men.

Amylene Hydrate—Amyleni Hydras, $C_2H_5.C(CH_3)_2.OH$ (Tertiary Amyl Alcohol).—Amylene hydrate has an effect similar to that of paraldehyde, but it is used only as a solvent for tribromoethanol.

LOCAL ANESTHETICS

Action.—The important action of this group of drugs is paralysis of the peripheral sensory nerves. They abolish all sensations, including taste and smell, although their chief effect is on the nerves of pain. Their effect is local, and they must be brought in contact with the nerve in effective concentration. Some must be injected in the area of the nerve, while others can penetrate the mucous membranes. For various surgical purposes they can be injected subcutaneously, producing anesthesia in a small area, into one of the larger nerve trunks to anesthetize a considerable area, or into the spinal canal producing an anesthesia suitable for operations on the abdomen or lower extremities. Epinephrine is frequently given with local anesthetics to constrict the blood vessels, thus prolonging the anesthesia and lessening hemorrhage.

Local anesthetics produce some undesirable effects. They stimulate the central nervous system, sometimes producing restlessness and tremors, followed by convulsions, and they may also produce circulatory stimulation or depression, depending on the drug. Barbiturates may be used to counteract the central nervous system stimulation.

Cocaine.—Cocaina.

Action.—As a local anesthetic, cocaine is used only by topical application. It penetrates the mucous membrane rather readily. It is never administered by injection because it is a general protoplasmic poison.

Cocaine is a vasoconstrictor and mydriatic; its properties are not found in other local anesthetics. It is often used as a vasoconstrictor in the relief of nasal congestion. It is seldom used in the treatment of the eye because of its mydriatic effect and harmful action on the cornea, being replaced by certain synthetic drugs.

Toxicology.—Acute poisoning. The symptoms are quickened respiration and pulse rate, excitement, dilated pupils, dry throat, headache, vertigo, confusion, and clonic convulsions. The stimulation is succeeded by depression, and death may occur from respiratory failure.

The treatment consists of gastric lavage and symptomatic treatment with particular attention to respiration and circulation.

Toxicology.—Chronic poisoning. This is usually a result of addiction. The symptoms are emaciation, fainting spells, disorders of the circulatory system, febrile attacks, insomnia, mental failure, disagreeable hallucinations, possible delirium and acute mania, and moral degeneration.

The patient must be hospitalized and given specialized treatment. The victims of this habit show a marked tendency toward the commission of crimes of violence. The sale of cocaine is regulated by the Federal Narcotic Act.

Cocaine Hydrochloride.

Procaine Hydrochloride—Procainae Hydrochloridum (Procaine, Novocaine).—It produces a local anesthetic effect when placed on the tongue.

Action.—Procaine is administered only by injection. It is about one-fourth as toxic as cocaine when injected. It is used for infiltration anesthesia, nerve block, or spinal anesthesia, in doses of 100 to 150 mg. For nerve block, a 1 or 2 percent solution is usually employed.

Procaine Hydrochloride Injection.

Sterile Procaine Hydrochloride.

Procaine Hydrochloride Tablets.

Procaine Hydrochloride and Epinephrine Injection.

Procaine Borate.—Has the same action and uses as the hydrochloride.

Phenacaine Hydrochloride. — Phenacainae Hydrochloridum (Holocaine).

Toxicology.—Phenacaine is as toxic as cocaine when injected intravenously and twice as toxic when injected subcutaneously because it is not as readily destroyed in the body. It is not suitable for injection, and its use is limited to topical application. It is largely used as a local anesthetic in the eye, usually in 1 percent solution. It is one of the few synthetic local anesthetics which rival cocaine in ability to penetrate the mucous membrane.

Tetracaine Hydrochloride—Tetracainae Hydrochloridum (Amethocaine Hydrochloride, Pontocaine).—Slightly bitter taste followed by numbness.

Action.—Tetracaine hydrochloride is a local anesthetic with actions similar to those of procaine hydrochloride, but it is effective when applied to mucous membranes in lower concentrations. It is used for surface anesthesia in the eye, nose, and throats and in spinal anesthesia in which the anesthesia is prolonged.

Ethyl Aminobenzoate.—Aethylis Aminobenzoas, $C_6H_4.NH_2.CO.OC_2H_5$ (Benzocaine, Anesthesin).

Action.—Because of its low solubility, it is usually prescribed as a local anesthetic in the form of dusting powders for relief of pain in wounds, or in lozenges for throat irritations, or in ointment for itching in various skin diseases.

Ethyl Aminobenzoate Ointment.—5 percent.

Butacaine Sulfate—Butacainae sulfas (Butyn sulfate).—Butacaine sulfate is used for surface anesthesia in the form of a 2 percent solution for eye, nose, and throat conditions.

Dibucaine Hydrochloride—Dibucainae Hydrochloridum (Nupercaine Hydrochloride).—It is used as a topical anesthetic on mucous membranes and for infiltration, and as a spinal and caudal anesthetic by injection.

Piperocaine Hydrochloride—(Metycaine Hydrochloride).—It is used topically for infiltration anesthesia, as a spinal anesthetic, and for caudal anesthesia.

ANTISEPTICS, GERMICIDES, FUNGICIDES, AND PARASITICIDES

The members of this group are chiefly employed by topical application for their local effect, but some are administered internally for their local action, as urinary or intestinal antiseptics.

Germicides kill all microorganisms, bactericides kill only bacteria, and antiseptics either kill or inhibit the growth of microorganisms.

Coal Tar—Pix Carbonas.—Coal tar contains the phenols, cresols, naphthalenes, and like substances which give it disinfectant and local anesthetic properties. It is used in the treatment of various skin diseases to relieve itching and combat inflammation. It is usually prescribed in the form of ointment. If used for too long a period, it may cause severe dermatitis.

Coal Tar Ointment.—5 percent.

Coal Tar Solution (Liquor Carbonis Detergens).—20 percent.

Chloroformic Coal Tar Solution.—5 percent coal tar.

Phenol.—Phenol, (C_6H_5OH) Carbolic Acid, Phenolic Acid, Phenolic Alcohol).

Action.—Locally, phenol is a general protoplasmic poison. In high concentration it precipitates protein. It is toxic to all types of cells. When applied to the skin it causes blanching, followed by sloughing of the tissue. It also has a local anesthetic effect. In adequate concentrations it is fungicidal and bactericidal. The bactericidal efficiency is reduced by cold and alkaline media and is greater in aqueous solution than in glycerin or fats.

Phenol has a marked effect, first stimulating and then depressing, on the central nervous system, particularly on the spinal cord. The blood pressure is lowered and circulation is greatly depressed. It is a powerful antipyretic.

Phenol is occasionally used in disinfection of inanimate objects. Well diluted, it is employed as an antipruritic in lotions or ointment. Aqueous solutions stronger than 2 percent should not be used. Phenol is added as a preservative to preparations in ampules. It is also used as a standard for comparison of disinfectant power. The term "Phenol Coefficient" is a number indicating the disinfectant value of a substance as compared with Phenol.

Toxicology.—The symptoms are local corrosion of the tissue, accompanied by severe pain; vomiting, the vomitus having the odor of phenol; general capillary damage resulting in low blood pressure; cold sweat, a marked fall in body temperature; scanty urine, containing albumin, casts, and free hemoglobin, usually green to black in color; shock, soon followed by death from respiratory failure.

Treatment

1. Gastric lavage using olive oil, which dissolves the phenol and delays absorption.
2. Allow some olive oil to remain in the stomach to act as a diluent and demulcent.
3. Administer saline injections to promote diuresis and protect the kidneys.
4. Give other symptomatic treatment as necessary.

5. If phenol is spilled on the skin, it can be removed effectively with alcohol or castor oil.

Liquefied Phenol—(Liquefied Carbolic Acid, Liquid Phenol).—It contains 10 percent water.

Phenol Ointment.—2 percent.

Cresol—Cresol, $CH_3.C_6H_4.OH$.—Cresol is a mixture of orthocresol, metacresol, and paracresol. It is a much more powerful disinfectant than phenol. In the form of the official saponated solution of cresol, it is principally used for disinfecting inanimate objects. It is about as poisonous as phenol, and the symptoms and treatment are the same.

Saponated Cresol Solution (Lysol, Compound Cresol Solution).

Betanaphthol—Betanaphthol (B-naphthol).—

Action.—Betanaphthol is a powerful disinfectant, stronger than phenol. It is used locally in the treatment of parasitic skin diseases, usually in the form of ointments. Internally it is used as a vermifuge, especially for hookworm, and as an intestinal antiseptic, but it is not often prescribed for internal use because of its toxicity. The symptoms and treatment of poisoning are the same as for phenol. Dose: 0.12 gm. (2 grains).

Trinitrophenol—Trinitrophenol, $C_6H_2OH(NO_2)_3$ 2:4:6, (Picric acid)—*Caution.*—Picric acid explodes when heated rapidly or when subjected to percussion. For safety in transportation, it should be mixed with 10 to 20 percent water.

Action.—Trinitrophenol has germicidal, astringent, and local anesthetic properties. It has a phenol coefficient of 6. It is used as a surgical disinfectant in about one-half to 1 percent solutions. It is also used in the form of a solution or "picric acid gauze" in the treatment of eczema, fever blisters, and other skin diseases. As an astringent, it is used in dusting powders for excessive sweating of the feet. Local application of high concentrations of this drug frequently causes a dermatitis known as "picric acid itch," characterized by severe pruritis, vesicle formation, edema, and acute weeping eczema.

Toxicology.—If taken orally, it produces symptoms consisting of severe gastroenteritis, nausea, vomiting, with vomitus stained yellow, intense headache, progressive stupor, and anuria. The skin often becomes yellow, acompanied by intense itching and sometimes eruptions resembling eczema. Coma and death may follow. Picric acid hemolyzes the red blood cells and causes acute nephritis and liver damage.

Treatment

1. Gastric lavage with egg albumin or milk.
2. Symptomatic treatment.

Parachlorophenol (4-Chloro-Phenol).

Action.—Parachlorophenol is used locally for its bactericidal action on gram-negative organisms. It is usually employed in the form of ointment.

Camphorated Parachlorophenol.—Parachlorophenol Camphoratum.

Resorcinol—Resorcinol, $C_6H_4(OH)_2$ (Resorcin, Metadihydroxybenzene).

Action.—The physiological properties of resorcinol resemble those of phenol, but it is about one-third as active as a fungicide or germicide. It is used principally in the treatment of skin diseases, such as ringworm, eczema, and psoriasis, in the form of an ointment or lotion.

Compound Resorcinol Ointment.—6 percent.

Resorcinol Monoacetate.—Resorcinolis Monoacetas (Resorcin Acetate, Euresol).

Action.—Resorcinol monoacetate liberates resorcinol slowly on hydrolysis. This gives it a longer action than resorcin. It is used in various skin diseases, especially of the scalp, in the form of solutions or lotions.

Undecylenic Acid—Acidum Undecylenicum (10-Hendecenoic Acid).

Action.—Undecylenic acid is a fatty acid, a component of sweat, used as a fungicide. It is used as an ointment or dusting powder.

Compound Undecylenic Acid Ointment (Dessenex Ointment).—5 percent undecylenic acid, 20 percent zinc undecylenate.

Zinc Undecylenate—Zinci Undecylenas.—It is used as a fungicide in the form of dusting powder or ointment.

Pine Tar—Pix Pini (Pix Liquida).—Pine tar owes its medicinal properties to the presence of creosote, guaiacol, phenol, and other phenolic bodies. Externally it is used as a stimulant and antiseptic in the treatment of various skin diseases, usually as an ointment. Internally it is used as an expectorant in the treatment of bronchitis. For internal used the rectified tar oil is commonly used.

Pine Tar Ointment (Ointment of Tar).—50 percent pine tar.

Rectified Tar Oil—Oleum Picis Rectificatum (Oleum Picis Liquidae Rectificatum, Tar Oil).—Rectified tar oil represents the medicinal properties of pine tar. It is used for the same purposes and is preferred for internal use because its taste is less offensive.

Pine Tar Syrup.—Dose: 10 cc. (2½ fluidrachms).

Compound Tar Ointment.—4 percent tar oil.

Juniper Tar.—Pix Juniperi (Cade Oil, Oleum Juniperi Empyreumaticum).

Action.—The medicinal properties of juniper tar are due to the presence of phenolic bodies such as guaiacol and cresol. It is used as an antiseptic and fungicide in the treatment of chronic eczema, psoriasis, and other skin diseases. It is an efficient parasiticide in the treatment of scabies and certain other skin afflictions. It is usually prescribed in ointments. Juniper tar is often incorporated in soaps and shampoos.

Compound Soft Soap Liniment (Compound Green Soap Tincture).—2 percent juniper tar.

Compound Resorcinol Ointment.—2 percent juniper tar.

Rectified Birch Tar Oil—Oleum Betulae Empyreumaticum Rectificatum (Oleum Rusci).—Used in the treatment of chronic eczema and other skin diseases.

Thymol.—Thymol.

Action.—Thymol is a bactericide and fungicide. It is more active than phenol against pathogenic cocci but less active against Gram-negative bacteria. It is more active as a fungicide and is effective in the treatment of epidermophytosis and ringworm. It is used in the form of ointments and dusting powders. It is also effective against hookworm. Dose: anthelmintic, divided into three doses, 2 gm. (30 gr.)

Toxicology.—The symptoms are epigastric pain, nausea, and vomiting. If large amounts are absorbed there is evidence of central stimulation, resulting in garrulity and confusion. The face is flushed, the pulse rapid, often there is headache and sometimes roaring in the ears and temporary deafness. The patient may lapse into unconsciousness. Death occurs from cardiac failure. Thymol is a depressant to the heart.

Treatment

1. Gastric lavage.
2. Symptomatic treatment.

N. F. Antiseptic Solution (Antiseptic Solution).

Alkaline Aromatic Solution (Alkaline Antiseptic Solution).—These preparations are used as irrigations.

Ichthammol—Ichthammol (Ammonium Ichthosulfanate, Ichthyol).—Ichthammol is a demulcent, emollient, and antiseptic. It is used in the treatment of skin disorders and to promote healing in chronic inflammations, usually in the form of the ointment but sometimes as a suppository.

Ichthammol Ointment—10 percent.

Chrysarobin.—Chrysarobinum.

Action.—The chief active constituent is largely a complex mixture of reduction products of chrysophanic acid. Chrysarobin is used as a parasiticide in the treatment of parasitic skin disease, such as psoriasis and ringworm. It is one of the most effective agents used in psoriasis. It is usually employed in ointments. It is absorbed through the skin and appears in the urine, coloring it red. Unless well diluted, it is very irritating to the skin.

Chrysarobin Ointment.—6 percent.

Benzyl Benzoate—Benzylis Benzoas.—The benzyl ester of benzoic acid.

Action.—Applied in the form of the lotion, it is effective as a scabicide and for the eradication of head lice; orally it is used as an antispasmodic in spasms of the smooth muscle, particularly the uterus. It may be administered in doses of 1 to 2 teaspoonfuls of 20 percent alcoholic solution, diluted with milk or water and unsweetened.

Benzyl Benzoate Lotion.—25 percent.

Saponated Benzyl Benzoate.—A concentrate which is diluted with three parts of water to give the finished lotion.

Benzyl Benzoate Chlorophenothane Lotion.

Action.—The insecticidal action of the chlorophenothane increases the efficiency of the lotion as a scabicide and pediculicide. The ethyl aminobenzoate allays itching. The emulsifying agent in the lotion is polysorbate 80 (Tween 80).

Chlorophenothane (DDT).—Only the purified grade of DDT should be used in medicinal preparations.

Precipitated Sulfur.—Sulfur Praecipitatum, S.

Action.—Sulfur has both germicidal and fungicidal action. In contact with the skin it is converted into pentathionic acid, which accounts for its therapeutic activity. It is also a parasiticide. When taken internally, it has a cathartic action. Sulfur is used in the treatment of various skin diseases, such as ringworm, scabies, psoriasis, seborrhea, and eczema.

Sublimed sulfur and washed sulfur are also official. Washed sulfur may be used in the same way as precipitated sulfur. Sublimed sulfur is very seldom used in skin preparations because its crystalline structure has an irritating effect. Both precipitated and washed sulfur are administered internally in the same dose. Dose: 4.0 gm. (60 grains.)

Sulfur Ointment.—10 percent.

Peruviam Balsam—Balsamum Peruvianum (Peru Balsam).—Used as a stimulating and protective dressing in indolent ulcers and for its antiseptic and fungicidal properties in the treatment of epidermophytosis.

Iodine—Iodum, I.—Iodine is effective as a germicide against all bacteria. It is unique in showing little selective action; the concentration necessary for disinfection is practically the same for all microorganisms. It is also an effective fungicide.

Action.—Iodine is used chiefly as a skin disinfectant for application to wounds and abrasions. A 2 percent solution is used for application to mucous membranes. It is also employed in the treatment of skin infections because of bacteria and fungi. It is sometimes used to sterilize water; one drop in a quart of water will disinfect it against bacteria and amebae. Iodine is an effective chemical antidote for alkaloidal poisonings.

Toxicology.—Its toxic effects are largely due to corrosive action on the gastrointestinal tract. The symptoms are epigastric and abdominal pain; diarrhea, possibly with bloody stools; brown stain on the mucous membrane of the mouth; vomiting. If starch is present in the stomach the vomitus may be blue. The large amount of fluids lost in diarrhea and vomiting may result in shock. Death is caused by shock, acute corrosive gastritis, and asphyxiation due to edema of the glottis.

Treatment

1. Gastric lavage with chemical antidotes, such as starch or solution of sodium thiosulfate.
2. Symptomatic treatment.

Some patients have an idiosyncracy for iodine and may develop a skin rash even from a local application.

Strong Iodine Solution (Lugol's Solution).—5 percent Iodine and 10 percent KI. Dose: 0.3 cc. (5 min.)

Iodine Tincture (Mild Iodine Tincture).—2 percent.

Strong Iodine Tincture.—7 percent Iodine.

Iodine Ampules (Iodine Swabs).—2 percent Iodine.

Iodine Solution.—2 percent Iodine.

Iodine Ointment.—4 percent Iodine.

Iodides Tincture (Decolorized Iodine Tincture).

Stainless Iodized Ointment.

Benzalkonium Chloride.—Benzalkonii Chloridum (Zephiran Chloride, Alkyldimethyl-benzylammonium Chloride).

Action.—This is one of the newer antiseptics of the cationic type, in which the active ion bears a positive charge. It is used in various concentrations as a disinfectant and fungicide. Solutions have a low surface tension and foam when shaken. The benzalkonium ion is incompatible with anionic wetting agents, including soap, which should not be used with it or before its use for disinfecting the skin.

For disinfection of the skin a 1:1,000 solution is used; for wet dressings and irrigations of the eye, ear, nose, and throat, a 1:10,000 to 1:5,000 solution; for sterile storage of instruments, a 1:5,000 to 1:1,000 solution, to each liter of which 2 gm. of sodium nitrite and 5 gm. of sodium carbonate should be added to prevent rust.

Benzalkonium Chloride Solution.

Anthralin.—Anthrolinum.

Anthralin is used in ointments in strength of 0.1 to 1.0 percent as a treatment for psoriasis, chronic dermatomycosis, and for stimulating action in chronic dermatoses.

Anthralin Ointment.—1 percent.

OXIDIZING ANTISEPTICS

Action.—These drugs are toxic to microorganisms because they liberate nascent oxygen, which exerts a germicidal action by oxidizing the constituents of the bacterial protoplasm. The microorganisms most susceptible to their action are the Gram-positive bacteria and certain spirochetes and trypanosomes. The antiseptics of this group differ in the ease with which oxygen is liberated, the actions of cation linked with the oxygen anion, and the substance remaining after the oxygen is released.

Hydrogen Peroxide Solution—Liquor Hydrogenii Peroxidi (Hydrogen Dioxide Solution, Peroxide).—It deteriorates on standing or on contact with many oxidizing and reducing substances. It is decomposed by heat, light, and agitation.

Action.—Hydrogen Peroxide Solution is an active germicide only while it liberates oxygen. It is used most extensively in full or half strength in the cleansing of wounds. It is effective as a mouth wash in treatment of Vincent's angina and is a beneficial irrigation in the treatment of Trichomonas vaginalis vaginitis. It is also employed to loosen impacted wax in the ears.

Medicinal Zinc Peroxide—Zinci Peroxidum Medicinale.—Medicinal Zinc Peroxide releases nascent oxygen slowly. It is used in the form of a suspension as a dressing for badly infected wounds, particularly those infected with anaerobic bacteria. For this purpose, it should be sterilized in small quantities by heating for 4 hours at 140° C., then mixed with sterile distilled water into a creamy suspension. It is also used as a wash by suspending in water for the treatment of certain oral infections.

Gold Sodium Thiosulfate—Auri et Sodii Thiosulfas.—It is used as an antibacterial and antiarthritic.

Caution.—All gold salts are toxic. Toxic reactions are controlled by regular examinations of the skin, mouth, and blood.

Sterile Gold Sodium Thiosulfate.—Dose: To be determined by the physician.

Sodium Perborate.—Sodii Perboras, $NaBO_3.4H_2O$.

Aromatic Sodium Perborate.

Sodium Perborate Monohydrated.—It contains 16 percent available oxygen.

Action.—It is a powerful oxidizing agent. It is used as an antiseptic in irrigations of the urethra and vagina and as a fungicide in the treatment of athlete's foot and other fungus skin infections, by soaking. Solutions are employed to oxidize the venom in snake bites. It is used as a wet dressing in treatment of poison ivy, and in solution as a chemical antidote for poisoning by various drugs.

CHLORINE DISINFECTANTS

Chlorine disinfectants act by liberating free chlorine. In medicine this action has been utilized by the employment of chlorinated lime and alkaline solutions of sodium hypochlorite and potassium hypochlorite. Hypochlorite preparations are fairly stable in the presence of alkali, and alkaline hypochlorite preparations have the added advantage that the alkali has a destructive and solvent action on most bacteria and other organic matter. In the treatment of infected wounds with hypochlorite solutions, an excessive degree of alkalinity is considered objectionable on the ground that it causes destruction of normal tissue and irritation of the skin.

The term "available chlorine" refers to the amount of chlorine which can be liberated from a compound. The chlorine disinfectants are used principally as surgical antiseptics, wound dressings, and irrigations.

Sodium Hypochlorite Solution.—Liquor Sodii Hypochloritis (Chlorox).

Caution.—This solution is not suitable for application to wounds. Diluted with about four parts water it is used as a foot bath for prophylaxis against ringworm and other fungus infections. It is also used to disinfect inanimate objects. It is too strong to be applied to wounds. Labarraque's Solution, which is used as a cloth bleach, may be prepared by diluting Sodium Hypochlorite Solution with equal parts of water.

Diluted Sodium Hypochlorite Solution.—Liquor Sodii Hypochloritis Dilutus (Modified Dakin's Solution).

Used as a surgical antiseptic, particularly for suppurating wounds, where it also dissolves necrotic tissue. It has the disadvantage, common to all hypochlorite antiseptics, of dissolving blood clots, delaying clotting, and dissolving ligatures, catgut, silk, and horsehair.

Chloroazodin—Chloroazodinum (Azochloramid).—Used in the form of solutions or ointments as a surgical antiseptic and as an irrigation for deep wounds and pus pockets and superficial suppurating wounds.

Chloroazodin Solution.—0.26 percent.

Glyceryl Triacetate—Glycerylis Triacetas (Triacetin).—Used as a solvent for chloroazodin.

Chloramine-T. — Chloramina-T (Chlorazene, Sodium Paratoluenesulfonchloramide).

Action.—Chloramine-T is less active than the hypochlorites because its chlorine is not released as rapidly in solution. It has less solvent action on necrotic tissue but has a longer duration of action. It has a phenol coefficient of 50. It is used in 1 to 2 percent solution as a surgical antiseptic for wounds and as an irrigation to mucous membranes.

SILVER PREPARATIONS

Silver compounds have a wide variety of uses as caustics, astringents, antiseptics, and germicides. Their activity resides in the silver ion, which is a protein precipitant. It is toxic to bacteria by precipitating the protein in the bacterial protoplasm. It exerts the same action on body tissues, the ion present in the active silver salts being particularly potent. Silver compounds are of two types, the simple silver salts, which ionize readily in solution, and the colloidal silver preparations, in which the silver does not exist to any large extent as free ions. The two classes differ greatly in their pharmacological action.

Action.—The simple silver salts are highly germicidal. Only one, Silver Nitrate, is official. They are very destructive to tissue and may be classed as caustics and corrosives as well as germicides. They have two stages of action: (1) The immediate germicidal and irritant action due to precipitation of protein by the free silver ion; (2) the milder and sustained antiseptic effect brought about by the formation of a protein silver compound which slowly liberates small amounts of ionic silver. Colloidal silver compounds, which contain very little ionizable silver, exert only the second action. Use of any silver preparation over a long period may cause a discoloration of the skin and mucous membrane known as argyria.

The colloidal silver preparations contain high concentrations of silver, largely in nonionized form. Their antiseptic value depends on the activity of the free silver ions and not on their content. They do not precipitate protein but penetrate the tissues more readily than does silver nitrate. Those mentioned here are silver proteins and silver halides.

Colloidal silver preparations are used as antiseptics, particularly for application to the mucous membranes of the eye, nose, throat, urethra, bladder, and colon. They are commonly used for infections of the upper respiratory tract. They are also effective as prophylaxis against gonorrhea, in urethral irrigations about 1 hour after exposure. They are prepared in the form of solutions, ointments, swabs, suppositories, and tampons.

Silver Nitrate.—Argenti Nitras, $AgNO_3$.

Action.—Silver Nitrate is used in solutions varying from 0.01 to 10 percent. It is used as a mild antiseptic and astringent in irrigations of the bladder and urethra; as a germicide in treatment of infected ulcers of the mouth and throat; as a prophylaxis against gonorrheal conjunctivitis, applied to the eyes of the newborn in 1 percent solution; in concentrated solution as a styptic.

Toxicology.—The symptoms are gastroenteritis, convulsions, profound changes in respiration, paralysis, and coma. The treatment consists of the prompt administration of a chemical antidote, such as any soluble nontoxic chloride, sulfate, soap, or weak alkalis, followed by symptomatic treatment.

Toughened Silver Nitrate.—Argenti Nitras Induratus (Silver Nitrate Pencils, Fused Silver Nitrate, Lunar Caustic).—It is used for its caustic and escharotic effect in the removal of warts, corns, and moles.

Silver Nitrate Ophthalmic Solution.—1 percent $AgNO_3$.

Mild Silver Protein—Argentum Proteinicum Mite (Mild Protargin, Argyrol, Silvol).—**Cau-**

tion: Solutions should be freshly prepared and dispensed in amber-colored bottles.

It contains about 19 to 23 percent of silver, but only a very small amount is in ionic form. Its therapeutic uses are given in the discussion of colloidal silver preparations. It is used in solutions varying in strength from 5 to 50 percent.

Strong Silver Protein—Argentum Proteinicum Forte (Strong Protargin, Protargol).—**Caution:** Solutions should be freshly prepared and dispensed in amber-colored bottles. It contains about 8 percent of silver but has more ionizable silver than mild silver protein and is therefore stronger and more irritant. It is used in solutions of about ¼ to 4 percent strengths. Its therapeutic uses are mentioned under colloidal silver preparations. Silver Protein Solutions are best prepared by sprinkling the powder on water and allowing to dissolve.

Colloidal Silver Chloride—Argenti Chloridum Colloidale.—It has the same uses as the other colloidal silver preparations.

Colloidal Silver Iodide—Argenti Iodidum Colloidale (Neo-silvol).—It has the same therapeutic uses as the other colloidal silver preparations.

COPPER SALTS

Copper salts are germicidal and fungicidal astringents. They are used in the treatment of fungus infections, and since their astringent action makes them irritant to the stomach, they are sometimes employed as emetics in poisoning.

Cupric Sulfate.—Cupri Sulfas, $CuSO_4.5H_2O$ (Copper Sulfate, Blue Stone, Blue Vitriol).

Action.—Cupric Sulfate is commonly used as a fungicide and also as an astringent in treatment of chronic conditions of the mucous membrane. It is given as an emetic in poisoning and as a chemical antidote in phosphorus poisoning. It is used as a hematinic in combination with iron salts, as copper, to aid in the utilization of iron in the body.

Toxicology.—The symptoms are a metallic taste in the mouth, nausea, vomiting, severe pains in the stomach, and violent headache. The tissue with which it came in contact may be stained black. The stools are frequent, black, and bloody; the urine is yellow and there is pain on voiding. There may be convulsions, followed by death.

Treatment

1. Give the chemical antidote, potassium ferrocyanide, which forms an insoluble cupric ferrocyanide.
2. Soap, alkalis, albuminous drinks, or milk will serve as chemical antidotes.
3. They all form insoluble compounds which should be removed by gastric lavage.
4. Symptomatic treatment.

MERCURY COMPOUNDS

Action.—The inorganic mercury compounds have an antiseptic action. Their activity depends on the release of the "mercuric" ion, which has an affinity for protein and precipitates it. This action is not selective for bacterial protoplasm, so these compounds are very irritating to tissue, have poor penetrating power, and lose much of their germicidal power in the presence of a large amount of protein. They are very toxic after absorption. The ones which ionize most completely corrode metal and cannot be used for disinfecting instruments. Spores are resistant to mercury compounds.

Toxicology.—Acute poisoning usually results from oral ingestion of some highly ionizable salt like mercury bichloride. Early in the poisoning, the mouth and pharynx become ashen gray. There is severe epigastric pain, a metallic taste in the mouth, and vomiting, which helps to rid the stomach of the poison. If allowed to remain in the stomach, the mercury salt is absorbed, and systemic reactions will occur. If the poison reaches the intestines there is severe irritation, resulting in profuse bloody diarrhea, which may cause shock and death. The patient usually recovers from the local symptoms if vomiting has been sufficient and the chemical antidotes have been administered. Systemic reactions may occur in a few hours and last for several days, finally causing death. The pulse is irregular and faint, respiration shallow, skin cold and clammy, features pinched, saliva metallic in taste and excessive in secretion, breath foul, gums sore, and the gum line colored blue. Later the teeth become loose. Severe diarrhea may cause acidosis, and widespread capillary damage may cause shock. Kidney damage is usually the cause of death.

Treatment

1. Emetic or gastric lavage.
2. Use of the chemical antidote sodium formaldehyde sulfoxylate is recommended. The stomach is washed with 250 cc. of a 5 percent solution, and another 250 cc. is allowed to remain in the stomach.
3. It may also be injected into the circulation, using about 10 gm. in 200 cc. of fluid. The sodium formaldehyde sulfoxylate forms a less soluble monovalent salt.
4. Other antidotes are albuminous drinks, milk, and egg white.
5. Immediate lavage must follow to prevent absorption of the mercury albuminate formed.
6. Symptomatic treatment to relieve pain, maintain normal composition of body fluids, and treat shock and acidosis.
7. Dimercaprol (BAL) is very useful in treating heavy metal poisoning.

Chronic poisoning is usually the result of exposure to inorganic mercury compounds over an extended period of time. The symptoms are stomatitis, colitis, progressive kidney damage, loss of appetite, nutritional disturbances, anemia, mental depression, and insomnia. The treatment consists of removal of the source of poisoning and symptomatic treatment. The response is slow and the illness may last for several years.

Mercury.—Hydrargyrum, Hg (Quicksilver).

Action.—Metallic mercury in bulk is not absorbable, but in a finely divided state it is taken up from the intestinal tract. It is probably absorbed as an albuminate or oxide and produces its effect as the mercuric ion. Its elimination is rather slow, giving it a cumulative action. It has an inhibitive action of the Treponema pallidum. At one time strong mercurial ointment was used in the form of "Mercury Rubs" for the treatment of syphilis. Mass of mercury is also an antiluetic. Mild mercurial ointment is used in the treatment of infestation with lice.

Metallic mercury is prescribed in its official preparation.

Mild Mercurial Ointment (Diluted Mercurial Ointment, Blue Ointment).—10 percent mercury.

Strong Mercurial Ointment (Mercurial Ointment).—50 percent mercury.

Mercury Mass (Blue Mass, Blue Pill).—Dose: 0.2 gm. (3 grains), 33 percent mercury.

Mercury Bichloride—Hydrargyri Bichloridum, $HgCl_2$ (Corrosive Sublimate, Mercuric Chloride).—**Caution:** Extremely poisonous.

It is commonly used as a disinfectant for inanimate objects and unabraded skin. A 1:1,000 solution is used to sterilize certain surgical instruments which cannot be boiled. A 1:500 to 1:1,000 solution is used to rid the body and head of lice. It is marketed in the form of the official Poison Tablets. These must conform to the official requirements: (1) The shape must be angular and not discoid; (2) the color must be anything but white; (3) they must be packaged in containers having an angular shape with roughened edges; and (4) the container must bear the word "Poison" on the label and state the quantity of $HgCl_2$ in each tablet.

Mercury Bichloride Large Poison Tablets.

Mercury Bichloride Small Poison Tablets.

Mercury Bichloride Ophthalmic Ointment.

Mild Mercurous Chloride.—Hydrargyri Chloridum Mite, HgCl (Calomel, Mercurous Chloride).

Action.—It is not as toxic as mercuric chloride because it is insoluble. It is a slow acting cathartic, affecting both the upper and lower bowel. It is used as an antiseptic in the form of ointments or dusting powders for ulcers and venereal ulcers. In ointments, it is used in the treatment of certain eye conditions and as an antiluetic for prophylaxis after exposure. Dose: 0.12 gm. (2 grains).

Mild Mercurous Chloride and Sodium Bicarbonate Tablets.

Mild Mercurous Chloride Ointment (Calomel Ointment).—30 percent.

Compound Mild Mercurous Chloride Pills (Compound Cathartic Pills).

Mild Mercurous Chloride Tablets.—Dose: 0.12 gm. (2 grains).

Yellow Mercuric Oxide—Hydrargyri Oxidum Flavum, HgO (Yellow Precipitate).—Used in the form of an ointment as an antiseptic in the treatment of eye infections, also in certain skin infections.

Yellow Mercuric Oxide Ointment.—1 percent.

Ammoniated Mercury.—Hydrargyrum Ammoniatum, $HgNH_2Cl$ (White Precipitate).

Action.—It is used in the treatment of parasitic skin diseases such as fungus infections and impetigo in the form of the ointment. Care must be taken not to rub it into the skin too vigorously, as it may produce dermatitis or be absorbed with undesirable effects.

Ammoniated Mercury Ointment (White Precipitate Ointment).—5 percent.

Ammoniated Mercury Ophthalmic Ointment.—3 percent.

Red Mercuric Iodide—Hydrargyri Iodidum Rubrum, MgI_2 (Biniodide of Mercury).—It is an active antiseptic. It is usually made into a solution with the use of potassium iodide, forming a complex salt, potassium mercuric iodide, a powerful germicide having the advantage over mercuric chloride of not precipitating protein. This solution will decompose unless an excess of potassium iodide is present. Red Mercuric Iodide is also used as an antiseptic in the treatment of skin disease. Combined with sodium iodide it is occasionally prescribed for the treatment of syphilis. Dose: 4 mg. (1/16 grain).

Potassium Mercuric Iodide.—Potassii Hydrargyri Iodidum.

Mercuric Salicylate.—Hydrargyri Salicylas.

Action.—It is used chiefly in the treatment of syphilis, by intramuscular injection. Being insoluble, it is nonirritant and slow in absorption. Injections should not be given oftener than once a week, as it is eliminated slowly, and there is danger of cumulative action. It is also used in about 10 percent strength as an antiseptic dusting powder and suspended in a mucilage as a urethral injection. Dose: Intramuscular in oil, 60 mg. (1 grain).

Mercuric Salicylate Injection.—Dose: Intramuscular, 60 mg. (1 grain).

Mercuric Succinimide.—Hydrargyri Succinimidum.

It is used in the treatment of syphilis. It has the advantage of being less irritant than the other soluble mercury salts. It is given either orally or by hypodermic in the same dose. Dose: Intramuscular, 15 mg. (1/4 grain).

Mercury Succinimide Injection.—Dose: Intramuscular, 15 mg. (1/4 grain).

Merbromin—Merbrominum (Mercurochrome—220 Soluble).—Merbromin is not an active germicide but it is a bacteriostatic agent, inhibiting bacterial growth. It is nonirritating to the tissue but does not penetrate living tissue readily, and its bactericidal activity is greatly reduced by organic matter.

It is used as a mild antiseptic for minor cuts and in surgery in a 1 percent solution to wash out internal cavities. The official 2 percent Surgical Solution is used to prepare the skin for operation.

Merbromin Solution.—2 percent.

Surgical Merbromin Solution.—2 percent.

Nitromersol — Nitromersol. — Nitromersol is used only in the form of the sodium salt as a topical antiseptic and to disinfect the skin and surgical instruments. It is not very effective against sporulating organisms.

Nitromersol Solution (Metaphen Solution).—0.2 percent Nitromersol.

Nitromersol Tincture (Metaphen Tincture).—0.5 percent Nitromersol.

Thimerosal—Thimerosal, $C_9H_9HgNaO_2S$ (Sodium Ethylmercurithiosalicylate, Merthiolate).—Thimerosal is a bacteriostatic for many nonsporulating bacteria. It is also a fungicide. It is used in the form of 1:1,000 tincture on intact skin. For wounds an aqueous solution 1:1,000 is used, and for ophthalmologic use, an aqueous solution 1:5,000 to 1:10,000. For application to nasal mucous membranes, an aqueous solution 1:5,000 to 1:30,000 is employed. The ointment and jelly are used as antiseptics.

Thimerosal Jelly.—0.1 percent.

Thimerosal Ointment.—0.1 percent.

MISCELLANEOUS ANTISEPTICS

Boric Acid—Acidum Boricum (Boracic Acid).—Boric Acid is obtained from borax by treating it with hot solutions of hydrochloric or sulfuric acid. When Boric Acid is mixed with salicylic acid, the combination acts as an alkaloidal precipitant.

Action.—Boric Acid is a weak antiseptic. Aqueous solutions inhibit bacterial growth. They are nonirritating and therefore suitable for application to delicate structures. In aqueous solution, Boric Acid is used as an antiseptic irrigation for the eyes, nasal passages, mouth and bladder. The ointment, dusting powder, and solu-

tions are employed in the treatment of skin diseases, bed sores, and similar conditions.

Toxicology.—Oral ingestion of Boric Acid may cause nausea, vomiting, abdominal pain, diarrhea, headache, weakness, visual disturbances, renal injury, and possible collapse. The treatment is symptomatic.

Boric Acid Ointment.—10 percent.

Boric Acid Solution.—5 percent.

Boroglycerin Glycerite.—31 percent.

Benzoic Acid.—Acidum Benzoicum, C_6H_5COOH (Flowers of Benzoin).

Action.—Benzoic Acid is an active bactericide and fungicide. It is used in the form of an ointment in treatment of fungus infections of the skin. Its salts, such as sodium benzoate, are used as food preservatives in canning. About 0.1 percent of sodium benzoate is sufficient for this purpose.

Benzoic and Salicylic Acid Ointment (Whitfield's Ointment).

Methylparaben—Methylparabenum (Methyl Parasept, Solbrol).—Methylparaben is used as a preservative in making pharmaceutical preparations. The strength usually employed is from 0.05 to 0.25 percent.

Propylparaben—Propylparabenum (Propyl Parasept).—Propylparaben is used as a preservative in pharmaceutical preparations. It is usually used in the strength of 0.02 to 0.2 percent. A combination of the Methyl and the Propyl paraben has a "synergistic" antiseptic action.

Formaldehyde Solution.—Liquor Formaldehydi (Formalin).

Action.—Formaldehyde is an irritant and general protoplasmic poison. In high concentrations it precipitates protein, and even in low concentrations it is toxic to cells. In proper concentrations, it is an effective germicide against all forms of organism. It is used as a disinfectant for inanimate objects. Well diluted, it is employed as irrigations for vaginal infections, fungus infections of the skin, and poison ivy. Because of its astringent action, it is sometimes used in about 20 percent solution to check excessive sweating.

Toxicology.—Symptoms may be noted after exposure to formaldehyde gas, including intense irritation of the eyes and respiratory tract, resulting in conjunctivitis, coryza, bronchitis, and even pneumonia. If taken by mouth, there is irritation of the mouth, throat, and gastrointestinal tract, with severe pain, vomiting, and diarrhea. It depresses the central nervous system and may cause symptoms similar to alcohol intoxication, such as vertigo, depression, and coma. Convulsions occur rarely. Severe acidosis may result from the formation of formic acid. The urine is scant, containing red cells and casts.

Treatment

1. Gastric lavage.
2. Use of demulcents.
3. Symptomatic treatment.

Methenamine.—Methenamina $(CH_2)_6N_4$ (Hexamethylenetetramine, Hexamethylenamine, Formin, Urotropin).

Action.—Methenamine is a weak antiseptic. When taken internally, it is circulated through the body fluids unchanged and is rapidly excreted in the urine. In acid urine, formaldehyde is released, with an antiseptic effect. Since urinary antiseptics act best in an acid medium, Methenamine is usually prescribed with a urine acidifier such as ammonium chloride or sodium biphosphate. Dose: 0.5 gm. (7½ grains).

Methenamine and Sodium Biphosphate Tablets.

Mandelic Acid.—Acidum Mandelicum. $C_6H_5CH(OH)COOH$ (Racemic Mandelic Acid).

Action.—Mandelic Acid is an efficient urinary antiseptic. For best results, a urine acidifier may be necessary. Its salts, Ammonium and Calcium Mandelate, not only act as antiseptics but also acidify the urine, creating a proper medium for their bacterial action. Dose: 3 gm. (45 grains).

Ammonium Mandelate Tablets.—Dose: 12 gm. (3 drachms).

Calcium Mandelate—Calcii Mandelas.—Dose: 4 gm. (60 grains).

Calcium Mandelate Tablets.—Dose: 4 gm. (60 grains).

MEDICINAL DYES

The medicinal dyes are employed as antiseptics, chemotherapeutic agents against protozoa, wound healing agents, and diagnostic agents for the determination of renal and hepatic functions.

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They may be classified chemically as azo, acridine, flourescein, phenolphthalein, rosaniline, and miscellaneous dyes.

AZO DYES

The azo dyes are used as wound healing agents. They stimulate proliferation of epithelial cells and are used in the treatment of wounds, burns, ulcers, and bedsores. They are usually applied in the form of an ointment or emulsion.

Scarlet Red.—Rubrum Scarlatinum (Scarlet Red Medicinal, Biebrich Scarlet Red).

Scarlet Red Ointment.—5.0 percent.

Scarlet Red Sulfonate.

ACRIDINE DYES

The acridine dyes are yellow. When first introduced, they were called "flavines." They possess marked antiseptic and germicidal properties, which are weakened in the presence of serum. They are not irritating or toxic to tissue.

Acriflavine.—Acriflavina (Neutral Acriflavine, Acriflavine Base).

Action.—Acriflavine is used in treatment of wounds, inflammations of the gums, throat infections, urethritis, gonorrheal infections, and otitis media, applied as an ointment or in solution by wet dressings or irrigation. It is sometimes given orally as a urinary antiseptic. The urine should be alkaline to permit its action.

Acriflavine solutions are not stable and should be discarded within one week after preparation. They are affected by light and should be stored in amber-colored bottles.

Acriflavine Hydrochloride.—Acriflavinae Hydrochloridum.

Proflavine Dihydrochloride—Proflavinae Dihydrochloridum.—Proflavine has a more rapid action than acriflavine but is less toxic and germicidal.

Proflavine Sulfate.—Proflavinae Sulfas.

ROSANILINE DYES

These dyes are not very strong bactericides, but they are effective against Gram-positive bacteria. They are used as antiseptics for infected wounds, mucous membranes, and serous surfaces and for the treatment of fungus infections of the skin. Gentian Violet is used as an anthelmintic, particularly against roundworms and pinworms. The rosaniline dyes used in medicine are gentian violet, brilliant green, and basic fuchsin.

Methylrosaniline Chloride—Methylrosanilinae Chloridum (Gentian Violet, Methyl Violet, Crystal Violet).—Dose: 60 mg. (1 grain).

Methylrosaniline Chloride Jelly.—1 percent.

Methylrosaniline Chloride Solution.—1 percent.

MISCELLANEOUS DYES

Methylene Blue—Coeruleum Methylenum, (Methylthionine Chloride).—Solutions have a deep blue color.

Action.—Methylene Blue is a weak bactericide but is more efficient as a bacteriostatic. In low concentrations it inhibits the growth of the Mycobacterium tuberculosis. In a 1:1,000 solution it is bactericidal against Staphylococci. It was formerly used as a urinary antiseptic but has been largely replaced by more effective drugs. It is employed in a 1 percent solution in the treatment of Trichomonas vaginalis. It is administered orally in capsules or tablets to inhibit the growth of intestinal protozoa. It has also been used in cases of quinine-resistant malaria. Dose: 0.15 gm. (2½ grains).

Methylene Blue has two opposite actions on the hemoglobin. In high concentrations it converts hemoglobin into methemoglobin, while in low concentrations it hastens the conversion of methemoglobin back to hemoglobin.

SULFONAMIDES

Action.—There are two factors in the mechanism of action of the sulfonamides: (1) The direct action of the drug, producing a bacteriostasis; (2) the involvement of the defense forces of the host, the leucocytes. The drug inhibits the growth of the bacteria and allows the leucocytes to cope with the infection. Leucocytes are essential to the bactericidal action.

The essential growth substance of many bacteria is para-aminobenzoic acid. Since the sulfonamides are similar in structure to para-aminobenzoic acid, they can displace it from the enzymatic

reaction and inhibit the growth of the bacterial cells. There must be enough sulfonamide present to displace all of the para-aminobenzoic acid, so large doses are necessary at the beginning of therapy to build up the proper blood level. Sulfonamides have no beneficial pharmacological action aside from their effect on bacteria. Some patients experience toxic reactions such as cyanosis, nausea and vomiting, headache, dizziness, drug rash, and acidosis. Acute hemolytic anemia is not uncommon; leukopenia may occur at any time; granulocytopenia may occur between the fifteenth and fortieth day of therapy. In treating these reactions, it is advisable to discontinue the drug, administer fluids, give sodium bicarbonate to overcome acidosis, give blood transfusions if necessary, and treat symptomatically.

Certain routine procedures should be observed during therapy with sulfonamides. A proper blood level should be maintained, and complete blood count and urinalysis should be done before and during the course of treatment.

Sulfonamides are also administered locally. Pus and necrotic tissue should be removed before the sulfonamides are applied, as they oppose the action of sulfonamides. The drug may be sprinkled on the wound as a powder or applied as an ointment to infected areas. Local application is not always effective.

Sulfonamides are administered orally, intravenously, rectally, by retention enema, and topically. For detailed individual descriptions of the sulfonamides, refer to New and Nonofficial Remedies.

Sulfanilamide.—Sulfanilamidum.

Action.—Sulfanilamide has a potent antibacterial effect on group A hemolytic Streptococci, meningococci, gonococci, E. Coli and Proteus vulgaris of the urinary tract, and certain other organisms. It is used in the treatment of scarlet fever, erysipelas, mastoiditis, meningococcic meningitis, chancroid and lymphopathia venereum, trachoma, follicular conjunctivitis, and in mixed infections of the kidney and pelvis. In the treatment of gonorrhea it has been largely replaced by sulfathiazole, and sulfadiazine. It should be administered with sodium bicarbonate to overcome possible acidosis. Dose: 2 gm. (30 grains).

The sulfonamides are ineffective against syphilis, tuberculosis, malaria, typhoid fever, and common colds.

Sulfanilamide Tablets.—Dose: 2 gm. (30 grains).

Sulfapyridine.—Sulfapyridinum.

Action.—It is used in the treatment of bacterial pneumonias, meningitis, gonorrhea and other infections of the urinary tract, streptococcal infections, trachoma, and lymphogranuloma. The daily urine output should be maintained at not less than 1,000 cc. to avoid hematuria and obstruction by formation of acetylsulfapyridine crystals. There is no disturbance in the acid-base equilibrium, so it is unnecessary to give sodium bicarbonate in conjunction with this drug. Dose: 2 gm. (30 grains).

Sterile Sulfapyridine Sodium.—Dose: 2 gm. (30 grains).

Sulfapyridine Tablets.—Dose: 2 gm. (30 grains).

Sulfathiazole.—Sulfathiazolum.

Action.—Sulfathiazole is less toxic than sulfapyridine. Unlike the other sulfonamides, it is rapidly excreted, and a suitable blood level is difficult to maintain. It diffuses less rapidly into the spinal fluid than other sulfonamides.

It is used in the treatment of bacterial pneumonias, meningitis, staphylococcal bacteremia, boils and carbuncles, cellulitis, osteomyelitis, severe streptococcal infections, gonorrhea, and acute bacillary dysentery. The daily urine output should be maintained at not less than 1,000 cc. to avoid hematuria and kidney obstruction caused by formation of crystals. Dose: 2 gm. (30 grains).

Sulfathiazole Tablets.—Dose: 2 gm. (30 grains).

Sulfathiazole Sodium.—Dose: 2 gm. (30 grains).

Sulfathiazole Sodium Injection.—Dose: 2 gm. (30 grains).

Sterile Sulfathiazole Sodium.—Dose: 2 gm. (30 grains).

Sulfadiazine.—Sulfadiazinum.

Action.—It is of relatively low toxicity and is well tolerated in the body. Effective blood levels with this drug are rapidly reached and sustained

on therapeutic oral doses. A daily urine output above 1,000 cc. should be maintained to avoid urinary obstruction. Forced fluids and sodium bicarbonate are recommended with this drug.

Sulfadiazine is effective in treatment of pneumococcic pneumonia and meningococcic and pneumococcic meningitis, in the prophylaxis and treatment of gonorrheal and other genitourinary tract infections, in severe hemolytic streptococcic and staphylococcic infections, and in other sulfonamide-susceptible infections. Dose: 2 gm. (30 grains).

Sulfadiazine Tablets.—Dose: 2 gm. (30 grains).

Sulfadiazine Sodium.—Dose: 2 gm. (30 grains).

Sterile Sulfadiazine Sodium.—Dose: 2 gm. (30 grains).

Sulfadiazine Sodium Injection.—Dose: 2 gm. (30 grains).

Sulfamerazine.—Sulfamerazinum.

Action.—Sulfamerazine is closely related chemically to sulfadiazine but is much more rapidly absorbed from the intestinal tract and more slowly excreted, so it need not be given as frequently or in as large doses to maintain proper blood levels. In a free state it is more soluble than sulfadiazine at any pH, and in the acetylated form it is less likely to have a toxic reaction in the kidney. It passes readily into the cerebrospinal, pleural, and abdominal fluids. An alkaline urine output above 1,000 cc. per day should be maintained.

Sulfamerazine is used for the same purposes as sulfadiazine. Dose: 2 gm. (30 grains).

Sulfamerazine Tablets.—Dose: 2 gm. (30 grains).

Sulfamerazine Sodium.—Dose: 2 gm. (30 grains).

Sulfamerazine Sodium Injection.—Dose: 2 gm. (30 grains).

Sterile Sulfamerazine Sodium.—Dose: 2 gm. (30 grains).

Sulfaguanidine.—Sulfaguanidinum.

Action.—It reaches bacteriostatic and bactericidal concentrations in the intestinal tract and exerts its antibacterial action there. It causes very little toxic reaction. It differs from most sulfonamides in being poorly absorbed from the gastrointestinal tract.

Sulfaguanidine is used in the prophylaxis and treatment of bacillary dysentery. It should not be given for more than 2 weeks, and if the response is unsatisfactory it should be discontinued after 1 week. Dose: 2 gm. (30 grains).

Sulfaguanidine Tablets.—Dose: 2 gm. (30 grains).

Succinylsulfathiazole. — Succinylsulfathiazolum (Sulfasuxidine).

Action.—It has low toxicity and is poorly absorbed from the intestinal tract, where it exerts a bacteriostatic effect against certain bacteria, particularly the Gram-negative organisms such as E. coli and dysentery bacilli of the Shiga, Flexner, and Sonne strains. In therapeutic doses it has an inhibiting effect on intestinal flora, resulting in semifluid, practically odorless stools of low bacterial count. It is recommended for preoperative preparation and postoperative treatment of patients requiring surgical operations of the rectum, carcinoma of the colon, fecal fistula, and other operations of the intestinal tract. It is also used in the treatment of acute bacillary dysentery, carriers of dysentery bacilli, and prophylaxis of dysentery. It can be administered for as long a period as necessary. Dose: 2 gm. (30 grains).

Succinylsulfathiazole Tablets.—Dose: 2 gm. (30 grains).

Phthalylsulfathiazole (Sulfathalidine).

Action.—It is used in the treatment of intestinal infections caused by sulfonamide-susceptible organisms. It is useful in the treatment of inflammation of the intestinal tract and for the presurgical treatment of patients who are to be subjected to surgery of the small intestine or colon. Dose: 2 gm. (30 grains).

Phthalylsulfathiazole Tablets.—Dose: 2 gm.—(30 grains).

The choice of the sulfonamide compound to be used for the control of known infections should be based on: (1) Bacteriologic diagnosis; (2) knowledge of the experimental therapeutic background of the drugs; (3) their pharmacological properties in man; (4) their clinical efficiency; and (5) the variety, frequency, and severity of the toxic actions which may be produced. When these factors are considered, selection may be made from the drugs in the following chart.

SULFONAMIDE DRUGS OF CHOICE

	First	Second
Hemolytic streptococcus infection due to Lancefield group A organisms.	Sulfadiazine. Sulfamerazine. Sulfapyrazine.	Sulfanilamide.
Pneumococcic infections	Sulfadiazine. Sulfamerazine.	Sulfathiazole.
Gonococcic infections	Sulfathiazole. Sulfadiazine.	
Staphylococcic infections	Sulfadiazine. Sulfamerazine. Sulfathiazole.	
Meningococcic infections	Sulfadiazine. Sulfamerazine. Sulfapyrazine.	Sulfathiazole. Sulfanilamide. Sulfapyridine.
Friedlander's bacillus infection	Sulfadiazine.	Sulfapyridine.
Shigella dispar and hemophilus influenzae infection	Sulfadiazine.	
Chancroid	Sulfanilamide and others.	
Acute bacillary dysentery	Sulfadiazine. Sulfathiazole. Succinylsulfathiazole. Sulfaguanidine.	

ANTIBIOTICS

Antibiotics are products of living microorganisms which kill or inhibit the growth of other microorganisms. In 1929 Fleming discovered the bacteriolytic effect of the mould Penicillium notatum on a culture of Staphylococcus aureus. In 1936 at Oxford University Florey and his assistants isolated the active principle and named it penicillin. In the meantime bacteriologists and chemists were seeking similar substances. In 1939 Dubos isolated an extract from Bacillus brevis, a strain of soil bacteria, which he named tyrothricin. Streptomycin was discovered by Waksman in 1943. Several other antibiotics have been developed, but only a few are effective and nontoxic in the human body. In some, the toxicity has been greatly reduced by purification of the principle. They have been developed from moulds (as penicillin), actinomyces (as streptomycin), and bacteria (as tyrothricin).

PENICILLIN.—Penicillin is the antibacterial substance derived from the mould. Penicillium notatum or Penicillium chrysogenum. Several isomeric forms have been identified and designated as penicillin F, G, K, and X. Commercial preparations contain principally penicillin G, but a few have appreciable amounts of penicillin X. These forms differ in their therapeutic effectiveness against different organisms. Penicillin X is more effective against gonorrheal infections, but penicillin G is more effective against syphilis. Penicillin F and K are for the most part inactivated in the body, so the blood levels attained following their administration is low, and their therapeutic actions are feeble. These forms are very hard to crystallize.

Action.—Penicillin has a selective action against certain bacteria. It is chiefly effective against certain strains of aerobic and anaerobic Gram-positive organisms. Most Gram-negative organisms such as E. coli, Bacillus typhosus, and the Salmonella, and certain strains of Gram-positive organisms are highly resistant. It is effective against certain spirochetes, moulds, and viruses.

Penicillin is practically nontoxic. Some patients have urticarial reactions, even after local application.

Penicillin solutions are most stable at a pH between 5 and 7. They are inactivated by high

temperatures. Crystalline penicillin G is stable at ordinary temperatures, but its solution should be kept refrigerated.

Standardization.—The potency of penicillin is expressed in terms of the international unit, which is similar to the Oxford unit. It is the amount of penicillin activity which forms a zone of inhibition 24 mm. in diameter around a cylinder in an agar plate inoculated with Staphylococcus aureus and is equivalent to 0.6 microgram of crystalline sodium penicillin G.

Penicillin is effective in the treatment of:

1. All staphylococcic infections with or without bacteremia, such as acute and chronic osteomyelitis, carbuncles, meningitis, pneumonia, and wound infections.
2. All hemolytic streptococcic infections with bacteremia and all serous local infections, such as cellulitis, mastoiditis, pneumonia empyema, puerperal sepsis, peritonitis, and endocarditis.
3. All clostridial infections, such as gas gangrene.
4. All anaerobic streptococcic infections.
5. All pneumococcic infections of meninges, pleura, and endocardium.
6. All gonococcic infections.
7. All anthrax.
8. Vincent's angina infection.
9. Syphilis.

It is effective in the treatment of diphtheria, in conjunction with the antitoxin, and of actinomycosis. It is ineffective against typhoid, E. coli infections of the urinary tract, tularemia, tuberculosis, undulant fever, and other diseases caused by Gram-negative organisms.

Penicillin may be administered parenterally, orally in tablets or lozenges, or topically in ointments, creams, irrigations, or wet dressings. When it is given orally, a buffer such as sodium citrate, calcium carbonate, aluminum hydroxide gel, kaolin, magnesium oxide, or citric acid should be added to minimize gastric acidity.

Bacteria may became resistant to penicillin if subjected to sublethal concentrations of the drug, so it is essential that effective doses be administered at the beginning of the course of treatment.

Penicillin Potassium.—The potassium salt of an antibiotic substance produced by the growth of Penicillium notatum or Penicillium chrysogenum, or by other means. Dose: oral on a fasting stomach, 1,500,000 units; intramuscular, 300,000 units daily.

Penicillin G Potassium (Benzyl Penicillin Potassium, Crystalline Penicillin Potassium G).—Dose: oral on a fasting stomach, 1,500,000 units, or intramuscular, 300,000 units daily.

Penicillin G Procaine.—The procaine salt of Penicillin G.

Penicillin Sodium—Penicillium Sodicum.—The sodium salt of an antibiotic substance or substances produced by the growth of Penicillium notatum or Penicillium chrysogenum (Fam. Aspergillaceae) or by other means.

Description and dose are the same as for penicillin potassium.

Penicillin G Sodium (Benzyl Penicillin Sodium, Crystalline Penicillin Sodium G).—Dose: oral on a fasting stomach, 1,500,000 units or intramuscular, 300,000 units.

Buffered Crystalline Penicillin.

Penicillin for Inhalation.

Penicillin Procaine for Aqueous Injection.—Dose: daily, intramuscular, 300,000 units.

Penicillin Procaine in Oil Injection.—Dose: intramuscular, 300,000 units.

Penicillin Ointment.

Penicillin Tablets.—Dose: on a fasting stomach, 1,500,000 units.

Penicillin Troches.—Dose: 1 troche.

STREPTOMYCIN.—Streptomycin is the purified active principle obtained from the cultures of certain strains of the actinomycete, Streptomyces griseus. It is marketed as the hydrochloride and sulfate, both of which are freely soluble in water or normal saline solution.

Action.—Streptomycin is of low toxicity and is effective against both Gram-positive and Gram-negative bacteria. It is a drug of choice in Gram-negative infections of the urinary tract, Hemophilus influenza infections such as endocarditis, pulmonary infections, and meningitis, other types of meningitis due to Gram-negative bacteria, bacteremia, tularemia, middle ear infections, Shigella dysenteries, peritonitis, and Klebsiella (Friedlander) pneumonia. It has a suppressive effect on tuberculosis and is used in the treatment of all forms.

Streptomycin is administered parenterally. The initial dosage must be large enough to inhibit

or kill the microorganisms, or they may become streptomycin resistant.

The potency of Streptomycin is expressed in terms of the metric weight of pure streptomycin base. A streptomycin unit is equivalent to 1 microgram (0.001 mg.) of streptomycin base.

Dihydrostreptomycin.—It is produced by the hydrogenation of streptomycin. It is usually supplied in the form of the hydrochloride or sulfate.

Action.—Its uses are the same as those of streptomycin, but somewhat larger doses are given.

TYROTHRICIN.—Tyrothricin is an antibiotic extracted from the sporulating soil bacterium, Bacillus brevis. It contains two water soluble principles, tyrocidine and gramicidin. Tyrocidine is toxic to tissue cells and in buffered solutions is bactericidal against many organisms. Gramicidin is nontoxic and is more active than tyrocidine. It has a selective action against Gram-positive cocci and bacilli.

Action.—Tyrothricin is ineffective and toxic when administered orally or parenterally. Applied topically, it is effective in superficial infections with pneumococci, staphylococci, streptococci, and similar Gram-positive pathogens. It is used in the treatment of impetigo, pustular dermatitis, chronic abscesses, secondarily infected dermatitis, and similar surface infections when caused by predominating Gram-positive organisms, infected wounds, osteomyelitis, and certain infections of the eye and nasal sinuses. It is administered topically in a 1:2,000 solution. Higher concentrations are irritating to tissue. It is marketed as a 2 percent alcoholic solution, to be diluted before use.

Tyrothricin Solution.

Tyrothricin Spray (Prothricin, Glucothricil, Wyamine-Tyrothricin).—The spray contains 0.02 percent tyrothricin.

Tyrothricin Troches.—(Tyrozets, Lozilles, Teeds, Pemzoles).

AUREOMYCIN HYDROCHLORIDE.—The hydrochloride of several antibiotic substances produced by the growth of Streptomyces Aureofaciens or by other means.

Action.—It acts as a specific in the rickettsial diseases. It is useful in primary atypical pneumonia, lymphogranuloma venereum, granuloma inguinale, brucellosis, tularemia, pertussis, and herpes zoster. It is usually given orally, and some gastric distress may follow its use.

Aureomycin Hydrochloride Capsules.

CHLORAMPHENICOL (Chloromycetin).—An antibiotic produced by the growth of Streptomyces venezuelas and synthetically. A white or grayish white or yellowish crystalline powder.

Action.—It is effective in the rickettsial diseases. It is useful in brucellosis, pertussis, urinary infection caused by Ps. aeruginosa, E. coli, and Proteus vulgaris.

It is the drug of first choice in typhoid fever and may be used in the treatment of gonorrhea when caused by penicillin resistant organisms.

Chloramphenicol Capsule.

ANTHELMINTICS

Anthelmintics are drugs which expel, paralyze, or kill intestinal worms. They are divided into vermicides, which kill or paralyze the worm, and vermifuges, which cause its expulsion. Taeniacides and taeniafuges act on the tapeworm.

The worms which commonly infest man are pinworm, seatworm, whipworm, fluke, threadworm, roundworm, hookworm, and tapeworm. They infest the intestinal tract and some, particularly the flukes, penetrate the tissue of certain organs. They injure the host by robbing him of food, causing mechanical injury to the organs or obstructing ducts, producing toxic substances which may be absorbed by the host, and providing an entry for bacteria and other organisms by injuries to the body tissue.

Toxicology.—Most anthelmintics are toxic to the host as well as to the worm. Many of the older drugs are highly toxic, and they are being replaced by synthetic drugs which are safe as well as effective.

Two or three days prior to administration of the drug, the patient should be placed on a fat-free diet, high in protein and carbohydrate. It is usually given on an empty stomach and followed within a few hours with a saline cathartic.

Aspidium—Aspidium (Male Fern, Marginal Fern).—Aspidium contains about 1.5 percent filicin as the active constituent. It is particularly effective against tapeworm.

Toxicology.—Aspidium is an irritant to the intestinal tract. It stimulates the spinal cord, sometimes producing convulsions. The stimulation is followed by depression, affecting also the medulla, respiration, heart, and smooth muscle. In mild poisoning there may be headache and vertigo, followed by gastroenteritis, nausea and vomiting, visual disturbances, convulsions, and delirium. "*Treatment:* Immediate purging of the intestinal tract, symptomatic treatment.

Aspidium Oleoresin.—Single dose: 4.0 gm. (60 grains).

Chenopodium Oil—Oleum Chenopodii (American Wormseed Oil).—Used in the treatment of hookworm, roundworm (ascaris), and dwarf tapeworm infestation. Dose: as an anthelmintic for adults, single dose, 1 cc. (15 min.).

Toxicology.—The toxic actions of this drug make it undesirable, and it has been largely replaced by others less poisonous. Locally it has an irritant effect on the gastrointestinal tract. It has first a stimulating and then a depressing effect on the central nervous system and also affects sight and hearing. Large doses depress the heart muscle and lower blood pressure.

The symptoms are nausea, vomiting, ringing in the ears, impaired vision, shallow respiration, and possible convulsions. *Treatment:* A saline cathartic, symptomatic treatment.

Chenopodium Oil Capsules.—Dose: 1 cc. (15 min.).

Santonin—Santoninum—**Action.**—Santonin is a vermifuge, mainly effective against roundworms. It irritates the worms so that they migrate from the small intestine to the large intestine, from which they are eliminated alive and active.

Santonin is one of the simplest anthelmintics to administer, as it is tasteless and nonirritating. In small doses, its only noticeable effect is on the sight, causing yellow vision. In large doses it stimulates and then depresses the central nervous system and depresses the heart. •Dose: 60 mg. (1 grain).

Toxicology.—The symptoms are yellow vision, headache, vomiting, nausea, abdominal pain, diarrhea, depression of the heart, and respiration and possible convulsions. The skin may be cold and clammy, and a rash may develop. Treatment consists of gastric lavage, a saline cathartic, and symptomatic treatment.

Santonin Tablets.—Dose: 60 mg. (1 grain).

Santonin and Mild Mercurous Chloride Tablets.

Carbon Tetrachloride—Carbonei Tetrachloridum, CCl_4.

Action.—Carbon tetrachloride is one of the most effective vermicides against hookworms, but it is very toxic. It is a general protoplasmic poison. It is extremetly irritant to the skin and mucous membrane, and taken orally it irritates the gastrointestinal tract, stimulating peristalsis. It is a depressant to the central nervous system and the heart muscle. Dose: **Caution:** As an anthelmintic for adults, single dose, 3 cc. (45 min.). It is usually administered in capsules.

Toxicology.—Poisoning may be either acute or chronic. Both types may be caused by oral ingestion or inhalation of vapors. Acute poisoning is marked by abdominal pains, nausea, vomiting, diarrhea, hiccough, frequently severe headache, sometimes the appearance of alcoholic intoxication and convulsions. As absorption increases, a progressive narcosis occurs. The action of the drug on the heart may cause cardiovascular collapse.

In chronic poisoning the chief site of injury is the liver. Hepatic cirrhosis and jaundice may occur. Dermatitis, bronchitis, and conjunctivitis may result from exposure to fumes.

The treatment consists of gastric lavage or a saline cathartic and symptomatic treatment.

Carbon Tetrachloride Capsules.—Dose: 3 cc. (45 min.).

Tetrachloroethylene.—Tetrachloroaethylenum, C_2Cl_4 (Perchloroethylene, Ethylene Tetrachloride).

Action.—It is as effective as carbon tetrachloride against hookworm and is less toxic. It has a limited value against pinworms and seatworms. Dose: 3 cc. (45 min.).

Tetrachloroethylene Capsules.—Dose: 3 cc. (45 min.).

Hexylresorcinol.—Hexylresorcinol (Caprokol, Crystoids Anthelmintic).

Action.—Hexylresorcinol is a powerful vermicide of low toxicity, effective against hookworm, pinworm, dwarf tapeworm, whipworm, and ascaris. It is particularly useful in the treatment of debilitated persons or children. It is used locally as a germicide and disinfectant in a 1:1,000 solu-

tion commonly known as "S. T. 37" solution. It is occasionally used as a urinary antiseptic but has been largely replaced by the sulfonamides and methenamine.

It is administered orally in the form of pills with a hard gelatin coating. They should not be bitten into because contact of the drug with the mucous membrane may cause painful ulcerations. Dose: Anthelmintic, 1 gm. (15 grains).

Hexylresorcinol Pills.—Dose: 1 gm. (15 grains).

ARSENICALS

Arsenicals are divided into two classes, inorganic and organic. The inorganic arsenicals are powerful poisons, highly toxic to all cells, and are generally employed for their effects on body tissue. The organic arsenicals are less toxic to mammals but very poisonous to certain protoza. The main purpose in their use is to produce a maximal effect on the invading organism with a minimal effect on the body tissue.

They are used in the treatment of protozoal infections.

Arsenicals may be either trivalent or pentavalent. Only the trivalent compounds are active either toxicologically or therapeutically, but in the body the pentavalent arsenicals are reduced to the trivalent state.

Action.—Arsenic is a general protoplasmic poison. Locally it has a weak effect on the skin. At first it produces a mild irritation but prolonged application may cause cell injury and necrosis. It has a pronounced effect on circulation. Large doses cause extreme vasodilation, resulting in an escape of plasma from the circulation and a lowering of blood pressure, sometimes to shock level. The vasodilation in the gastrointestinal tract caused by small doses may result in increased secretion and absorption. Large doses may cause blisters to form in the intestines as a result of the escaping plasma. The blisters break, the epithelial fragments are cast off, and the plasma escapes. The presence of the plasma and the irritant action of the arsenic cause a diarrhea with "rice water" stools. Arsenic also damages the kidney capillaries, tubules, and glomeruli.

By its vasodilating effect, arsenic may aid the nutrition of the skin and give it a healthy appearance, but continued use may lead to abnormal proliferation of the skin, finally resulting in atrophy and degeneration, and may also cause peripheral neuritis. Arsenic affects the function of the bone marrow and alters the cellular composition of the blood. In a normal individual, small doses may lower the red cell count and large amounts may cause changes in the appearance of the cells. In anemia it may cause increase of the immature red cells and a decrease in the mature cells. Arsenic aids in the utilization of iron in the body and may act as an adjuvant to iron in the formation of red cells. It inhibits the formation of white cells when they are in excess and is used for this action in the treatment of leukemia.

Toxicology.—In acute poisoning the symptoms generally begin in from 15 to 30 minutes with an intense burning pain in the epigastrium, soon spreading to the whole abdomen. This is often accompanied by a constriction of the throat and an acrid, metallic taste, soon followed by violent vomiting and purging. The vomitus may be bilious or bloody. There is profuse diarrhea with characteristic "rice water" stools. As the poisoning progresses, thirst becomes excessive, urine is suppressed, the extremities are cold, the pulse rapid and weak, respiration rapid and labored and painful from abdominal tenderness, the skin is dark and cyanosed, and the patient suffers from violent cramps. Collapse, convulsions, and coma ensue, death occurring in from 5 to 30 hours.

Prompt evacuation of the stomach.

Even if the patient has vomited, gastric lavage is advisable.

Freshly precipitated ferric hydroxide may be used as a chemical antidote to form an insoluble arsenic compound in the stomach.

The patient should then be treated symptomatically, with particular attention to fluid loss and shock.

Chronic poisoning, which may result from repeated administration of small doses or exposure to arsenic compounds over a long period, is difficult to diagnose. The first symptoms may be associated with many disorders. They include weakness, loss of appetite, occasional nausea and vomiting, diarrhea or constipation, a garlicky odor on the breath, congestion of the conjunctivae and symptoms of acute coryza, salivation, stoma-

titis, dermatitis, loss of hair and nails, liver and kidney disorders, peripheral neuritis affecting the extremities, and blood disorders.

Treatment.—Removal of the source of poisoning and symptomatic treatment.

BAL (British Anti-Lewisite) is used in poisoning by such drugs as mapharsen. It is indicated in arsenic reactions, such as toxic encephalopathy, blood dyscrasies, dermatitis, and sudden febrile reactions occurring about 12 hours after administration of the arsenical. BAL has a greater affinity for the heavy metals than do the –SH groups in the cells and apparently removes the metal from the cell, forming a "metal-BAL compound." Probably a thioarsenite is formed which is rapidly eliminated from the body. BAL has the same action in mercurial poisoning. It is administered in oil.

Arsenic Trioxide.—Arseni Trioxidum, As_2O_3 (Arsenious Acid, Arsenious Oxide, "Arsenic").

Action.—Arsenic trioxide is trivalent. It is commonly employed in the treatment of leukemia, usually as solution of potassium arsenite. The solution is also used in treatment of Vincent's angina. It is occasionally used in conjunction with iron in the treatment of secondary anemias, a use common to the inorganic arsenicals. Dose: 2 mg. (1/30 grain).

Arsenic Trioxide Tablets.—Dose: 2 mg. (1/30 grain).

Potassium Arsenite Solution—(Fowler's Solution).—Dose: 0.2 cc. (3 min.).

Arsenious Acid Solution.—Dose: 0.2 cc. (3 min.).

Sodium Cacodylate.—Sodii Cacodylas, $Na(CH_3)_2AsO_2.3H_3O$.

Action.—This is an organic pentavalent arsenical. In the body it is converted into cacodylic oxide and then into inorganic arsenic and exerts its action in the inorganic form. Its actions and uses are the same as for arsenic trioxide. It is frequently prescribed with iron salts as a hematinic. It has the disadvantage of imparting a disagreeable odor to the breath. It is less toxic when administered parenterally than orally because the arsenic is released more slowly. The parenteral dose is about five times greater than the oral. Dose: oral, 60 mg. (1 grain).

Sodium Cacodylate Injection.—Dose: 0.3 gm. (5 grains) of sodium cacodylate.

Neoarsphenamine—Neoarsphenamina (Neosalvarsan).—Its solution needs no addition of alkali and is injected as soon as it is prepared. Solutions more than 20 minutes old should not be used. The injection is made slowly. Neoarsphenamine contains less arsenic than arsphenamine, is less toxic, causes fewer gastrointestinal reactions, and its injection is less irritating.

Action.—This is an organic trivalent arsenical. In the body it is converted into "arsen-oxides" which are rapidly destructive to trypanosomes and spirochetes. These oxidation compounds are responsible for its curative and toxic action, but neoarsphenamine in itself has been shown to be spirocheticidal outside the body. It is used in the treatment of serosyphilis, yaws, trypanosomiasis, Vincent's angina by local application, and in certain cases of malaria which have proven refractory to quinine. Dose: Intravenous, 0.45 gm. (7 grains).

Sulfarsphenamine.—Sulfarsphenamina.

Action.—Sulfarsphenamine was introduced because it can be administered intramuscularly and thus can be used in cases where the veins are inaccessible. It should not be administered intravenously, as it is about twice as toxic when given by vein. Immediate reactions are less common than with the other arsphenamines, but the toxic effects which may occur later make it the least desirable when a choice is possible. Its use in adults has been practically abandoned. Dose: Intramuscular, 0.45 gm. (7 grains).

Oxophenarsine Hydrochloride—Oxophenarsinae Hydrochloridum (Mapharsen).—Contains about 30 to 32 percent arsenic. It is usually marketed as a mixture with buffering agents and suitable substances to render its solution physiologically compatible with human blood. The manufacture and labeling of this drng and its mixtures are under the jurisdiction of the U. S. Public Health Service. The label must indicate the names of the admixed substances, and the composition of the mixtures containing oxophenarsine hydrochloride as the only active therapeutic agent must be approved by the National Institute of Health.

Action.—Oxophenarsine hydrochloride is a partial oxidation product of arsphenamine and has the same therapeutic uses. It is superior to neoarsphenamine and almost equal to arsphena-

mine as a treponemicide. It causes a rapid disappearance of the spirochetes, healing of the lesions, and a reversal of a positive Wassermann's reaction in most cases. Mapharsen is well tolerated in the body, causing fewer gastronintestinal disturbances than other arsphenamines. Its solutions are easy to prepare, stirring is permissible, and the pH is neutral. The injection is made rapidly, the entire dose being given in 15 to 30 seconds. Dose: Intravenous, 50 mg. (3/4 grain).

Dichlorophenarsine Hydrochloride—Dichlorophenarsinae Hydrochloridum (Chlorarsen, Dichlor-Mapharsen).—Dichlorophenarsine hydrochloride, like oxophenarsine hydrochloride, is usually mixed with buffering agents to render its solutions physiologically compatible with human blood. It is subject to the same regulation by the U. S. Public Health Service. In therapeutic uses it resembles arsphenamine. Dose: Intravenous, 45 mg. (3/4 grain).

Tryparsamide—Tryparsamidum.—Tryparsamide is a pentavalent organic arsenical. It is not chemically related to the arsphenamines. It differs from all other antiluetic arsenicals in being especially effective in the treatment of neurosyphilis. It has little value unless there is involvement of the central nervous system and is not as satisfactory as the arsphenamines in the treatment of serosyphilis. It is effective in the treatment of trypanosomiasis. Tryparsamide has a marked effect on the optic nerve, sometimes causing blindness. Dose: Intravenous, 2 gm. (30 grains).

ANTIMONY COMPOUNDS

Antimony is used a parasiticide in the treatment of protozoan infections, such as leishmaniasis, schistosomiasis, filariasis, and trypanosomiasis. It closely resembles arsenic as a chemotherapeutic agent. Locally it is more irritant than arsenic, producing pustules and vesicles on the skin. Its salts are emetics or, in smaller doses, nauseating expectorants.

Toxicology.—The symptoms are similar to those of arsenic. The outstanding effect of acute poisoning is shock, produced by pronounced vasodilation. Vomiting is considerable.

The treatment consists of gastric lavage with tannic acid, even if vomiting has occurred, followed by demulcents, opiates to relieve pain and diarrhea, and symptomatic treatment.

Antimony Sodium Thioglycollate—Antimonii Sodii Thioglycollas.—Used in the treatment of schistosomiasis and leishmaniasis. It is less toxic and less irritating than tartar emetic. It is administered intramuscularly or intravenously. Dose: 50 mg. (3/4 grain).

Antimony Sodium Thioglycollate Injection.—Dose: 50 mg. (3/4 grain).

Stibophen—Stibophenum (Fuadin).—Used in the treatment of lymphogranuloma inguinale and schistosomiasis. Dose: 0.2 gm. (3 grains).

Stibophen Injection.—Dose: 0.2 gm. (3 grains).

Suramin Sodium—Suraminum Sodicum (Naphuride, Bayer 205).—A potent trypanosomicide, being effective in both the first and second stages of the infection. It is slowly eliminated and remains active in the body for a considerable period, protecting it against reinfection with the trypanosomes of African sleeping sickness. It is also of value in the prophylaxis of this disease. Dose: Intravenous, 1 gm. (15 grains).

The cumulative effect of the drug or large doses may cause undesirable reactions, such as chill, fever, headache, nausea, pruritis, and occasionally conjunctivitis and stomatitis.

Sterile Suramin Sodium.—Dose: Intravenous, 1 gm. (15 grains).

ANTIMALARIALS

Quinine.—Quinina.

Action.—Locally quinine is a general protoplasmic poison. Like many other poisons, it stimulates in low concentrations and depresses in high concentrations. It has a paralyzing action on the sensory nerves, with a local anesthetic effect. It lowers body temperature and resembles the salicylates in analgesic potency. Therapeutic doses have little effect on the central nervous and cardiovascular systems, but large doses depress the heart and cause vasodilation. It has an oxytocic action on the uterus. It causes a decrease in leukocytes, particularly the polymorphonuclears. It is irritant to the gastrointestinal tract and increases the secretion of gastric juices. Large doses may cause nausea, vomiting, and diarrhea.

It is toxic to bacteria and many unicellular organisms, such as trypanosomes, yeast, plasmodia, and spermatozoa.

Quinine and its salts are used mainly in the treatment of malaria. It is the drug of choice in acute malaria. In the prophylaxis of the disease, it does not prevent infection but keeps the plasmodia at a low level of multiplication, so that the clinical symptoms do not develop. When the drug is stopped, the disease may appear. It overcomes the acute symptoms of malaria by depressing the multiplication of plasmodia and stimulating some of the parasites to change to a sexual form which cannot cause the disease in man. It is also used in the treatment of blackwater fever.

Quinine is used as an analgesic in the treatment of headache, muscular rheumatism, and neuralgia, as an antipyretic, and oxytocic, and a stomachic. Dose: 1 gm. (15 grains).

Toxicology.—The symptoms are ringing in the ears, a sensation of fullness in the head; larger doses may cause difficulty in hearing or deafness. There may be severe headache, flushed skin, disturbed vision, profuse sweating, abdominal pain, nausea, vomiting, purging, difficult breathing, general weakness, delirium, convulsions, and collapse. The treatment is symptomatic. The effects gradually wear off, although partial deafness may persist for several days.

Quinine Bisulfate.—Dose: 1 gm. (15 grains).

Quinine Dihydrochloride.—Dose: 1 gm. (15 grains).

Quinine Dihydrochloride Injection.—Dose: 0.5 gm. (7½ grains).

Quinine Hydrobromide.—Dose: 0.3 gm. (5 grains).

Quinine Hydrochloride.—Dose: Oral, 0.6 gm. (10 grains); intramuscular, 0.2 gm. (3 grains).

Quinine Phosphate.—Dose: 0.3 gm. (5 grains).

Quinine Sulfate.—Dose: 0.6 gm. (10 grains).

Quinine Sulfate Capsules.—Dose: 0.6 gm. (10 grains).

Quinine Sulfate Tablets.—Dose: 0.6 gm. (10 grains).

Quinine and Urea Hydrochloride.—A local anesthetic.

Quinine and Urea Hydrochloride Injection.—Dose: 0.5 gm. (7½ grains).

Quinine and Urethan Injection.—Sclerosing agent in the treatment of varicose veins.

Cinchona—Cinchona (Cinchona Bark, Peruvian Bark).—Dose: 1 gm. (15 grains).

Cinchona Alkaloids Elixir.—Dose: 8 cc. (2 fluidrachms).

Compound Cinchona Tincture.—Dose: 4 cc. (1 fluidrachm).

Cinchonidine Sulfate.—The action is similar to that of quinine but weaker. Dose: 0.15 gm. (2½ grains).

Cinchonine Sulfate.—Almost equal in strength to quinine but less frequently used. Dose: 0.15 gm. (2½ grains).

Totaquine—Totaquina.—Totaquine has the same uses as quinine. Dose: 0.6 gm. (10 grains).

Totaquine Capsules.—Dose: 0.6 gm. (10 grains).

Totaquine Tablets.—Dose: 0.6 gm. (10 grains).

Quinacrine Hydrochloride—Quinacrinae Hydrochloridum (Mepacrine Hydrochloride, Atabrin).—Quinacrine is a very valuable drug in the treatment of various malarial fevers. It does not overcome the clinical symptoms as quickly as quinine, but it causes a more rapid disappearance of the trophozoites from the blood. Like quinine, it reduces the clinical incidence of malaria but is not a positive preventative. In proper doses, it is well tolerated and more pleasant to take than quinine. It does not cause cinchonism and has no oxytocic effects. It has also been used in the treatment of blackwater fever. Dose: 0.1 gm. (1½ grains).

Continued use of quinacrine hydrochloride causes a yellow discoloration of the skin, sweat, tears, and urine, which usually disappears a few days after the treatment is stopped. Headache and gastrointestinal symptoms may occur but soon disappear.

Quinacrine Hydrochloride Tablets.—Dose: 0.1 gm. (1½ grains).

Pamaquine Naphthoate.—Pamaquinae Naphthoas (Aminoquin Naphthoate, Plasmochin).

Action.—This drug is more effective than quinine in destroying the sexual forms of the malarial parasite so that the blood is no longer infectious to the mosquito. In cases where full doses of quinine over a period of 3 weeks have not caused the disappearance of the sexual forms, plasmochin effects their elimination in a few days. It is not an effective prophylactic against malaria. It is not recommended as a substitute for quinine ex-

cept for patients who are sensitive to quinine, but the two are frequently used in conjunction. In this way the dose and toxicity of both can be reduced and both the gametocytes and schizonts are attacked. The relapse rate is considerably reduced.

The excretion of Pamaquine Naphthoate is slow, resulting in cumulative toxicity and causing gastric pain, nausea, headache, dizziness, cyanosis, and methemoglobinemia. Dose: 20 mg. (1/3 grain).

Chloroguanide Hydrochloride (Guanatol Hydrochloride, Proguanil, Paludrine, Drinupal)—**Action.**—It is used for prophylaxis and treatment of malaria. It is not as fast to act on acute attacks of malaria as some other drugs, but it has a very low toxicity. Dose: 300 mg. (5 grains).

Chloroguanide Hydrochloride Tablets.—Dose: 300 mg. (5 grains).

Chloroquine Phosphate.

Action.—Chloroquine Phosphate is a very effective antimalarial. It accomplishes a radical cure for falciparum malaria and is an excellent suppressive for vivax. It is less toxic than quinacrine and it does not stain the skin.

Chloroquine Phosphate Tablets.

Pentaquine Phosphate.

Action.—It is not used as a suppressive but as a radical cure of vivax malaria. It is chemically related to pamaquine, but is less toxic and more effective. It should not be given in conjunction with quinacrine, which raises its blood concentration and increases its toxicity. Dose: 0.1 gm. (1½ grains).

Pentaquine Phosphate Tablets.—Dose: 0.1 gm. (1½ grains).

AMEBACIDES

Emetine Hydrochloride.—Emetinae Hydrochloridum.

Action.—Emetine has a direct lethal action on the endamoeba histolytica. It is more effective against the motile forms than the cysts, as the concentrations strong enough to destroy the cysts cannot be tolerated by the body. Emetine is only employed to control the diarrheal or dysenteric symptoms. When these disappear, it is replaced by carbarsone, vioform, or chiniofon. It is effective in the treatment of amebic abscesses and in amebic hepatitis.

Emetine should never be administered in doses larger than 60 mg. per day or for a period longer than 10 to 12 days. During the course of therapy the patient should be closely observed for any toxic symptoms. Emetine is a general protoplasmic poison and may cause damage to the liver, kidney, and heart. The first symptoms are nausea, vertigo, and severe diarrhea with bloody stools. Dose: Intramuscular, daily, 60 mg. (1 grain).

Emetine Hydrochloride Injection.—Dose: 60 mg. (1 grain).

Chiniofon.

Action.—Chiniofon has a direct amebacidal action because of its iodine content. It is clinically effective against both the motile and the cyst forms, but is somewhat less rapid than emetine in its action on the motile forms. It acts only on the organisms in the intestinal tract and is ineffective in amebic abscesses and hepatitis. It is one of the safest and most efficient amebacides and is used in all forms of chronic and acute intestinal infection. It is less toxic than carbarsone. The patient need not remain in bed during the treatment, unless the disease makes it necessary. Chiniofon is nontoxic in therapeutic doses and rarely causes any toxic effects. Dose: 1 gm. (15 grains).

Chiniofon Tablets.—Dose: 1.0 gm. (15 grains).

Carbarsone—Carbarsonum.

Action.—Carbarsone is an organic pentavalent arsenical. Its direct amebacidal action is due to its arsenic content. It is effective against the cyst and motile forms. It acts only on infection in the intestines and is ineffective against amebae in abscesses of the liver and other organs. It is used in both acute and chronic cases. It is also employed in the treatment of Trichomonas vaginalis. It can be given orally or rectally and requires no special adjuvants, bed rest, or diets. It has very little toxic effect. Dose: Oral, 0.25 gm. (4 grains); rectal, 0.13 gm. (2 grains).

Carbarsone Capsules.—Dose: 0.25 gm. (4 grains).

Carbarsone Suppositories.—Dose: 0.13 gm. (2 grains).

Carbarsone Tablets.—Dose: 0.25 gm. (4 grains).

Diiodohydroxyquinoline (Diodoquin).

Action.—It is usually administered in the form of tablets, or in the treatment of intestinal amebiasis and also as a trichomonicide. Dose: 1.5 gm. (22 grains).

Diiodohydroxyquinoline Tablets.—Dose: 1.5 gm. (22 grains).

Iodochlorhydroxyquin (Vioform).

Action.—It is used internally for intestinal amebiasis and externally as a dusting powder for wounds and skin eruptions. Dose: Daily, 0.75 gm. (12 grains).

Iodochlorhydroxyquin Tablets.—Dose: 0.25 gm. (4 grains).

Compound Iodochlorhydroxyquin Powder.—The compound powder is used in the form of suppositories in the treatment of Trichomonas vaginalis vaginitis.

BIOLOGICALS

Biologicals are drug products, the manufacture of which depends upon the use of bacteria and bacterial products. They include serums, viruses, antitoxins, bacterial vaccines, antigens, extracts, and toxoids. They are used for prophylaxis, treatment, and diagnosis of infectious diseases. Their manufacture is controlled by the federal government. The manufacturer must be licensed by the Secretary of the Treasury and carefully examined by the U. S. Public Health Service.

The label on each package must state the name, address, and license number of the manufacturer, the proper name of the product, lot number, expiration date or date of manufacture or issue with period of potency, and the minimum potency or the fact that there is no standard of potency.

When biologicals are used as a prophylaxis, a condition of immunity is produced in the body. Immunity is a condition of the body which exempts it from contracting a contagious disease or which enables it to resist infection effectively. The resistance which exists normally in an animal or human being is termed natural immunity. The resistance to a disease which exists (1) after an attack of the disease or exposure to repeated small doses of infective material (for example, the immunity following a smallpox attack or the immunity that comes in later years of youth and adult life to diphtheria), or (2) after vaccination against it with a specific vaccine or virus (for example, the immunity following vaccination against smallpox and diphtheria) is termed acquired immunity.

There are two types of acquired immunity, active and passive. Active immunity is the immunity acquired by the individual himself, because he has had the disease or because the immunity to it has been artificially produced. Passive immunity is the immunity that depends upon defensive factors not originating in the person or animal protected but passively acquired by the injection of serum from another that has acquired an active immunity to the disease in question.

Some of the defense factors of immunity are—

1. **Antitoxins,** antibodies which neutralize the soluble toxins.
2. **Hemolysins or bacteriolysins,** antibodies which cause complete dissolution of the invading microorganisms.
3. **Opsonins or bacteriotropins,** antibodies which alter the invading microorganisms so that they are more easily destroyed by certain of the body cells (phagocytosis).
4. **Agglutinins and precipitins,** antibodies which agglutinate or precipitate the invading microorganisms.

An **antigen** is any substance that can cause the formation and appearance of specific antibodies in the circulation of animals. Chemical protein structure is the necessary criterion for an antigen, the important structural unit being the aromatic amino acids. The term "antigen" is also commonly used to designate certain materials that lack the power of stimulating the production of antibodies but which possess the property of entering into an immunologic reaction with some constituent of serum (for example, Wassermann antigen). Various kinds of antibodies may be produced by the same antigen.

The word "vaccine" or "cow disease," is from the Latin "vacca" (a cow). Cowpox was called "vaccinia" or "cow disease." The protection against smallpox vaccinia was designated "vaccination." A bacterial vaccine is a suspension of killed pathogenic bacteria in physiological salt solution to which a preservative has been added.

It is the same protein that causes the disease, so modified that it will not produce the disease, yet so little altered that it will stimulate the body cells to form the substance which will promptly destroy the infecting agent. The bacteria are killed in the preparation of vaccines by using heat or chemicals.

When bacteria have successfully invaded the body they produce disease through the following agencies:

1. Soluble or extracellular toxins, which are poisons generated by the bacterial cells and discharged into the surrounding media; for example, diphtheria and tetanus toxins (exotoxins).
2. Intracellular toxins (endotoxins), which are contained in the cell bodies and given off only after death of the bacteria; for example, typhoid endotoxin.
3. Toxinlike substances.
4. Bacterial proteins.
5. Mechanical action of bacteria.

Diphtheria toxin may be converted into toxoid which is nontoxic but has the same combining power with antitoxin as does the toxin from which it is derived. The conversion has been accomplished by heat or by treatment with different percentages of formaldehyde. Diphtheria toxoid treated or precipitated with alum has been found to be an effective immunizing agent.

Serums and antitoxins will produce a passive immunity. Antitoxins are obtained by immunizing a horse with repeated infections of the toxin. After several months the blood acquires a sufficiently high antitoxin content. The horse is then bled, the serum collected, processed, and standardized. Serums are obtained in a similar manner with other animals. Serums are administered both as prophylactic and curative agents.

Phenol, cresol, glycerin, and merthiolate are used as preservatives in biologicals.

Reference should be made to the U. S. P. and N. F. for details concerning official serums, antitoxins, vaccines, toxins, and toxoids.

ANTITOXINS

Diphtheria Antitoxin.—Dose: Parenteral, therapeutic, 20,000 units; prophylactic, 1,000 units.

Bivalent Gas Gangrene Antitoxin.

Pentavalent Gas Gangrene Antitoxin.

Trivalent Gas Gangrene Antitoxin.—Dose: Parenteral, therapeutic or prophylactic, one or more packages as the initial dose.

Scarlet Fever Streptococcus Antitoxin (Scarlet Fever Antitoxin).—Dose: diagnostic, not more than 0.2 cc.; therapeutic, 6,000 units; prophylactic, 2,000 units.

Tetanus Antitoxin.—Dose: Parenteral, therapeutic, 20,000 units; prophylactic, 1,500 units.

Tetanus and Gas Gangrene Antitoxin.—Dose: Parenteral, prophylactic, one or more packages.

TOXINS

Diagnostic Diphtheria Toxin (Schick Test Toxin, Diphtheria Toxin for Schick Test).—Dose: Intracutaneous, diagnostic, 0.1 cc. of the dilution.

Scarlet Fever Streptococcus Toxin (Dick Test Toxin).—Dose: Intracutaneous, diagnostic, 0.1 cc. of the dilution.

TOXOIDS

Diphtheria Toxoid (Diphtheria Anatoxid, Anatoxin-Ramon).—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated twice at intervals of 3 or 4 weeks for immunization.

Alum Precipitated Diphtheria Toxoid.—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated once after 4 to 6 weeks for immunization.

Diphtheria and Tetanus Toxoids (Combined Diphtheria and Tetanus Toxoids).—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated twice at intervals of 3 or 4 weeks for immunization.

Alum Precipitated Diphtheria and Tetanus Toxoids (Combined Diphtheria and Tetanus Toxoids, Alum Precipitated).—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated once after 4 to 6 weeks for immunization.

Diphtheria Toxoid and Pertussis Vaccine Combined.—Dose: Hypodermic, three repeated injections containing the dose of the toxoid and vaccine for immunization.

Tetanus Toxoid.—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated twice at intervals of 3 or 4 weeks for immunization.

Alum Precipitated Tetanus Toxoid.—Dose: Hypodermic, 0.5 or 1.0 cc. (as specified) repeated once after 4 to 6 weeks for immunization.

VACCINES

Cholera Vaccine.—Dose: hypodermic, 0.5, 1.0, and 1.0 cc. at intervals of 7 to 10 days for immunization.

Pertussis Vaccine.—Dose: hypodermic, 60,000 million bacteria in three repeated doses for immunization.

Alum Precipitated Pertussis Vaccine.—Dose: hypodermic, 30,000 million bacteria in three repeated doses at 4- to 6-week intervals for immunization.

Plague Vaccine.—Dose: hypodermic, 0.5, 1.0, and 1.0 cc. at 7- to 10-day intervals for immunization.

Rabies Vaccine.—Dose: hypodermic, one package, repeated at proper intervals.

Smallpox Vaccine.

Typhoid Vaccine.—Dose: hypodermic, 0.5 cc. repeated twice at intervals of 7 to 28 days for immunization.

Typhoid and Paratyphoid Vaccine.—Dose: hypodermic, 0.5 cc. repeated twice at intervals of 7 to 28 days for immunization.

Epidemic Typhus Vaccine (Typhus Vaccine).—Dose: hypodermic, 1.0 cc. repeated once in 7 to 10 days for immunization.

TUBERCULIN

Old Tuberculin—(Tuberculin-Kock, Concentrated Tuberculin, Crude Tuberculin).—Dose: diagnostic, intracutaneous, one 100 thousandth to one 10 thousandth cc.; therapeutic, subcutaneous, one 100 millionth to one millionth cc.

Purified Protein Derivative of Tuberculin (P. P. D.).—Dose: diagnostic, two 100 thousandths to two 10 thousandths mg.

SERUMS

Antimeningococcic Serum (Meningitis Serum, Meningococcus Serum).—Dose: parenteral, therapeutic, 20 cc.

Antipneumococcic Serum—Type Specific (Pneumonia Serum).—Dose: parenteral, therapeutic, 20,000 to 100,000 units.

Human Measles Immune Serum—(Measles Convalescent Serum).—Dose: parenteral, therapeutic, 20 cc.; prophylactic, 10 cc.

Human Scarlet Fever Immune Serum—(Scarlet Fever Convalescent Serum).—Dose: parenteral, therapeutic, 20 cc.; prophylactic, 10 cc.

Normal Human Serum.—The sterile serum obtained by pooling equal amounts of the liquid portion of coagulated blood from eight or more individuals free from diseases transmitted by blood transfusion at the time of drawing the blood. It is marketed as a liquid or dried serum. Dose: intravenous, 500 cc.

Immune Serum Globulin (Human) (Human Immune Globulin, Measles Prophylactic).—A sterile solution of Gamma Globulin which contains the antibodies normally present in adult human blood. Each lot is derived from the plasma or serum pool of at least 500 individuals. It is a transparent or slightly opalescent, colorless, or brownish liquid. Dose: intramuscular, for modification of measles 0.02 to 0.025 cc. per pound of body weight; for prevention of measles, 0.1 cc. per pound of body weight.

Citrated Normal Human Plasma (Normal Human Plasma).—The sterile plasma obtained by pooling equal amounts of the citrated whole blood liquid portion from eight or more individuals free from any disease transmissible by blood transfusion at the time of drawing the blood. It may be dispensed as a liquid, frozen, or dried plasma.

Normal Human Serum Albumin—Albuminum Seri Humanum Normale.—A sterile solution of the serum albumin component of blood from healthy donors. It complies with the official requirements of the National Institutes of Health of the United States Public Health Service. A moderately viscous, clear, brownish, odorless liquid.

Caution.—Do not use if turbid by transmitted light. Dose: intravenous, 25 gm. (100 cc. of 25 percent solution).

Anti-A Blood Grouping Serum—Serum Sanguis Dispositum Anti-A.—It is derived from high-titered serums of persons, with or without stimulation by the injection of group specific red cells or substances, or by similar treatment of lower animals. It agglutinates human red cells containing A agglutinogens. It is a clear or slightly opalescent fluid unless artificially colored, when it has a blue or blue-green color. The dried product is light yellow, unless artificially colored,

and is microscopically of a honeycomblike structure.

Anti-B Blood Grouping Serum—Serum Sanguis Dispositum Anti-B.—It is derived from high-titered serums of persons, with or without stimulation by the injection of group specific red cells or substances, or by similar treatment of lower animals. It agglutinates human red cells containing B agglutinogens. It is a clear or slightly opalescent fluid unless artificially colored and is microscopically of a honeycomblike structure.

Anti-Rh Typing Serum—Serum Exemplum Anti Rh.—It is derived from the blood of a person who has developed specific Rh antibodies. It is clear, slightly yellowish fluid, or, when dried, light yellow and microscopically of a honeycomblike structure.

Reference should be made to the U. S. P. and N. F. for details concerning official serums, antitoxins, vaccines, toxins, and toxoids.

IODIDES

Iodides are very useful in the treatment of tertiary syphilis, often bringing about marked improvement in syphilitic bone disease and soft tumors of the brain and other organs. They do not kill the spirochete but dissolve the tumor formed by the action of the parasite on the tissue, making it more readily accessible to the various spirocheticides employed. Iodides are also used as expectorants in bronchitis to increase the flow of secretions and render them less viscid. They are a source of iodine in the treatment of simple or nontoxic goiter, and are used in the treatment of lead poisoning to aid in elimination of lead, and in the treatment of arteriosclerosis.

Potassium Iodide—Potassii Iodidum, KI.—Dose: 0.3 gm. (5 grains).

Potassium Iodide Solution (Saturated Potassium Iodide Solution).—Dose: 0.3 cc. (5 min.).

Potassium Iodide Tablets.—Dose: 0.3 gm. (5 grains).

Sodium Iodide—Sodii Iodidum, NaI.—Dose: 0.3 gm. (5 grains).

Sodium Iodide Injection.—Dose: 1.0 gm. (15 grains).

Ammonium Iodide—Ammonii Iodidum, NH_4I.—Dose: 0.3 gm. (5 grains).

Diluted Hydriodic Acid.—Acidum Hydriodicum Dilutum.

Caution.—It should not be dispensed if it contains free iodine.

Hydriodic Acid Syrup.—Dose: 4.0 cc. (1 fluidrachm).

Ferrous Iodide Syrup.—Contains about 7 percent of FeI_2; combines the effects of the iodide and iron. Dose: 1.0 cc. (15 min.).

CALCIUM SALTS

The calcium ion is present in the extracellular fluid. The blood serum in a healthy man contains about 10 mg. of Ca per 100 cc. The average adult requires about 0.45 gm. of Ca daily. A deficiency of calcium in the blood results in a hyperirritability of the muscle fibers and nerve centers, and a lessening of the contractile power of the muscles. The heart beat becomes weaker and more rapid, violent convulsions may occur, and there is delay in the coagulation of the blood. If the cause of the deficiency is prolonged, the blood will compensate by withdrawing calcium from the bone.

Action.—Abnormal quantities of calcium in the blood result in an increase in the tone and systole of the heart, a lessening of the irritability of the nerve and muscle fibers, and a hastening of clotting of the blood.

Calcium is used in the treatment of various bone diseases, such as rickets, tetany, and osteomalacia, during pregnancy and lactation, and to hasten clotting of the blood. It is usually supplemented with phosphorus and vitamin D.

Calcium Chloride—Calcii Chloridum, $CaCl_2 \cdot 2\ H_2O$.—Calcium Chloride is administered intravenously. It is too irritating to the stomach to be given orally.

Calcium Chloride Injection.—Dose: 1 gm. (15 grains).

Calcium Gluconate—Calcii Gluconas.—It is less irritating than the chloride and may be given orally, intramuscularly, or intravenously. Dose: oral, 5.0 gm. (75 grains); intramuscular or intravenous, 1 gm. (15 grains).

Calcium Gluconate Injection.—Dose: 1 gm. (15 grains).

Calcium Gluconte Tablets.—Dose: 5 gm. (75 grains).

Calcium Lactate—Calcii Lactas.—It is less irritating than calcium chloride. Dose: 5 gm. (75 grains).

Calcium Lactate Tablets.—Dose: 5 gm. (75 grains).

Dibasic Calcium Phosphate—Calcii Phosphas Dibasicus, $CaHPO_4 2H_2O$ (Dicalcium Orthophosphate, Dicalcium Phosphate).—Dibasic Calcium Phosphate is claimed to be superior to other calcium salts in the treatment of calcium deficiency because it presents a more favorable calcium-phosphorus ratio. Dose: 1 gm. (15 grains).

DRUGS USED IN TREATMENT OF ANEMIAS

Iron.—Iron is essential to life. The body of an adult man contains about 3 gm. About 75 to 80 percent of this amount is present in the hemoglobin in a nonionizable form, the remainder being distributed in other body tissues. The normal daily requirement is about 5 to 8 mg.

Action.—When iron is absorbed from the food, it probably undergoes changes in the intestinal epithelium, enters the blood, and is finally taken up by the liver and stored there. From the liver it is released into the blood stream and utilized by the bone marrow in the formation of hemoglobin and new cells. Blood destruction takes place in the spleen; the iron is gradually given off and taken up again by the liver. The store of iron in the liver, spleen, and other tissues can be utilized to form hemoglobin.

Iron preparations are used to overcome nutritional disturbances. They improve nutrition by increasing the hemoglobin to normal. They are of particular value in anemias of low color index. Anemia with a color index below 0.6 is an iron deficiency anemia, also known as hypochromic anemia.

Certain ferric salts are used as styptics because of their astringent action.

Ferric Ammonium Citrate—Ferri Ammonii Citras (Iron and Ammonium Citrates).—Dose: 1 gm. (15 grains).

Ferric Ammonium Citrate Capsules.—Dose: 1 gm. (15 grains).

Ferrous Sulfate—Ferri Sulfas.—Dose: 0.3 gm. (5 grains).

Ferrous Sulfate Tablets.—Dose: 0.3 gm. (5 grains).

Exsiccated Ferrous Sulfate—Ferri Sulfas Exsiccatus, $FeSO_4$ (Dried Ferrous Sulfate).—Dose: 0.2 gm. (3 grains).

Ferrous Sulfate Syrup.—Dose: 8 cc. (2 fluidrachms).

Reduced Iron—Ferrum Reductum, Fe (Iron by Hydrogen).—Reduced Iron is of value because the iron particles are so finely divided that they are easily acted upon by the fluids of the intestinal tract. Dose: 0.5 gm. (7½ grains).

Ferrous Gluconate—Ferri Gluconas.—Dose: 0.3 gm. (5 grains).

Ferrous Carbonate Mass—(Vallet's Mass).—Dose: 0.6 gm. (10 grains).

Saccharated Ferrous Carbonate.—Dose: 0.25 gm. (4 grains).

Soluble Manganese Citrate—Mangani Citras Solubilis, (Manganese and Sodium Citrate).—Manganese is said to increase the hematinic effect of iron and is occasionally prescribed with iron compounds. Dose: 0.2 gm. (3 grains).

Peptonized Iron and Manganese Solution.—Dose: 8 cc. (2 fluidrachms).

Liver Extract—Extractum Hepatis (Dry Liver Extract).—A brownish powder, dry, somewhat hygroscopic, containing that thermostable fraction of mammalian livers which increases the number of red blood corpuscles in the blood of persons afflicted with pernicious anemia.

Action.—Liver produces a remarkable and almost immediate improvement in the blood condition in most cases of pernicious anemia. The improvement persists as long as the patient remains on the liver diet. About the fourth or fifth day of therapy, an increase in the number of reticulocytes is noted, and this increase continues until the maximum is reached about the ninth day. At the same time abnormalities of the cells disappear, and there are signs of clinical improvement. The patient feels better, his color improves, nausea disappears, and his intestinal condition is improved.

Liver is also used in other macrocytic anemias, and liver and iron are commonly prescribed in secondary anemias.

Liver is administered orally and parenterally. Dose: 1 U. S. P. unit.

Liver Injection.—Dose: intramuscular, daily, 1 U. S. P. unit.

Liver Solution.—Dose: oral, daily, 1 U. S. P. unit.

Liver Injection Crude.—A sterile solution in Water for Injection of the soluble thermostable fraction of mammalian livers which increases the number of red blood corpuscles in the blood. The potency of Liver Injection Crude is expressed in U. S. P. units (Injectable). It contains either one or two U. S. P. units (Injectable) in each cubic centimeter. Dose: intramuscular, daily, 1 U. S. P. unit.

Liver Concentrate.

Liver Desiccated (Desiccated Liver Substance).

Liver Fraction 1 (Soluble Liver Fraction).

Liver Fraction 2 (Insoluble Liver Fraction).

Powdered Stomach—Stomachus Pulveratus (Dried Stomach).—The dried and powdered defatted wall of the stomach of the hog, Sus scrofa var. domesticus (Fam. Suidae). It contains factors which increase the number of red blood corpuscles in the blood of persons affected with pernicious anemia. Its activity is rapidly destroyed when the preparation is suspended in hot liquid.

Action.—The fraction present in the stomach which is capable of increasing the number of red cells in the blood is formed by the combination of two factors: (1) the intrinsic factor, which is present in the glandular layer of the stomach and in the gastric juice; (2) the extrinsic factor, which is present in such foods as meats, eggs, milk, liver, and wheat germ.

Pernicious anemia is accompanied by disturbance in gastric secretion. It is probable that the disease is due to a deranged gastric function as a result of which the intrinsic factor is not present. Powdered Stomach is prescribed to supply this lack. Its effects are similar to those produced by liver. Occasionally liver and stomach are prescribed in combination. Stomach is also used in the treatment of other macrocytic anemias. Dose: 1 U. S. P. unit daily.

Liver With Stomach.—Dose: 1 U. S. P. unit daily.

Liver With Stomach Capsules.—Dose: 1 U. S. P. unit daily.

ENDOCRINE PRODUCTS

Posterior Pituitary—Pituitarium Posterius (Pituitary, Hypophysis Sicca).—The cleaned, dried, and powdered posterior lobe obtained from the pituitary body of domesticated animals used as food by man; a yellowish or grayish powder with a characteristic odor, partially soluble in water.

Its activity depends on the presence of two substances: oxytocin, which has oxytocic properties, and pitressin, which has vasodepressor and antidiuretic properties.

Action.—Posterior Pituitary stimulates the uterus. The uterus is more sensitive to the drug during the first 2 weeks of the menstrual cycle and during the progress of pregnancy. Its action on the heart is variable, but it causes a rise in blood pressure by constriction of the capillaries. It has an antidiuretic effect on the kidneys, said to be due to the presence of a hormone which is concerned with water metabolism. It has a stimulating effect on the intestinal muscles.

Posterior Pituitary is used as an oxytocic, as an antidiuretic in the treatment of diabetes insipidus, and as a stimulant to intestinal peristalsis in abdominal distention following abdominal operations.

Posterior Pituitary Injection.—Dose: intramuscular, 0.3 cc. (5 min.).

Oxytocin Injection.—A sterile solution in Water for Injection of the oxytocic principle from the posterior lobe of the pituitary body of healthy domesticated animals used for food by man. Dose: intramuscular, 0.5 cc. (8 min.).

Vasopressin Injection—(Solution Pitressin).—A sterile aqueous solution of the soluble pressor principle of the posterior lobe of the pituitary body of healthy domesticated animals used for food by man.

Action.—It is used to raise blood pressure, to relieve intestinal atony and that of the bladder following surgery, and for its antidiuretic action in diabetes insipidus. Dose: intramuscular, 0.5 cc. (8 min.).

Anterior Pituitary—Pituitarium Anterius (Pituitary Anterior Lobe).—The dried, partially

defatted, and powdered anterior lobe of the pituitary gland of cattle, sheep, or swine. It is free from diluents or preservatives. It is a yellowish gray, amorphous powder of characteristic odor and salty taste. No disagreeable odor, suggestive of putrefaction is present. It is partially soluble in water.

Action.—In addition to its own specific functions, the anterior pituitary gland regulates the activities of other organs of internal secretion, while its own functional activity is dependent on other glands. It secretes six different hormones.

1. *Somatotrophic hormone*, also known as the growth hormone, which regulates growth. A deficiency will cause pituitary dwarfism, in which the body is small but well developed and the features are small. In some cases the sexual organs are not properly developed. Excessive secretion will cause gigantism, a condition in which the individual is tall but of symmetrical growth, or a condition known as acromegaly, which is characterized by overgrowth of the bones of the hands, feet, face, and thorax. This hormone is used in the treatment of pituitary dwarfism. It is manufactured under the name of Antuitrin–G.

2. *Gonadotrophic hormone* or sex hormone, which affects both male and female sexual functions. A deficiency of this hormone in juveniles causes a failure in the development of the sex organs and secondary sex characteristics. In adults the sex organs show retrogressive changes. An excess of secretion causes a tendency toward sexual precociousness and premature puberty. In adults the sex organs tend to atrophy. The gonadotrophic hormone is divided into two parts: (a) the follicle stimulating hormone (FSH); (b) the luteinizing hormone (LH). In females the FSH stimulates the maturation of the ovarian follicles and the LH hastens luteinization and production of progesterone. In males the FSH induces spermatogenesis and development of the seminiferous tubules in the testes. The LH stimulates the production of testosterone.

A gonadotrophic hormone resembling that of the anterior pituitary is also found in urine of pregnant women and mares, and is believed to originate in the chorionic cells of the placenta. This hormone is marketed as Chorionic Gonadotrophic Hormone, or Antuitrin-S. It is used in the treatment of cryptorchidism, sexual infantilism, functional dysmenorrhea, amenorrhea, and menorrhagia.

(3) *Lactogenic hormone*, also called prolactin or luteoptrophin, which has to do with the secretion of milk by fully developed mammary glands. It is doubtful whether it has any effect on the development of the gland. It exerts a definite gonadotrophic effect in maintaining the life and function of the corpus luteum. It is used to treat functional uterine bleeding and to stimulate milk production in women who do not show signs of lactation by the sixth day after delivery.

(4) *Diabetogenic hormone* or ketogenic hormone, which controls the blood sugar level. A hypersecretion may cause an increase in blood sugar and in ketone bodies in the urine. It is possible that it is antagonistic to insulin.

(5) *Thyrotrophic hormone or thyrotrophin.*—A lack of this hormone results in atrophy of the thyroid gland. An excess causes marked hyperplasia of the thyroid, an increase in the basal metabolic rate, and symptoms of hyperthyroidism. It is marketed as Thyrotrophic Factor and is used in the treatment of thyroid hypofunction of pituitary origin.

(6) *Corticotrophic or adrenotrophic hormone*, also known as corticotrophin, which prevents atrophy of the adrenal cortex and on which the functional activity and structural integrity of the adrenal cortex depend.

The individual hormones are more effective for therapeutic use than the whole gland.

Desoxycorticosterone Acetate—Desoxycorticosteroni Acetas (Deoxycostone Acetate, Cortate, Doca, Precortate).—The adrenal gland is also known as the adrenal body, adrenal capsule, and suprarenal body. It is a flattened body situated behind the peritoneal tissue at the upper end of each kidney. It consists of an internal medulla and an external cortex. The medulla secretes the hormone epinephrine, which is discussed under sympathomimetic drugs. The cortex secretes the hormone desoxycorticosterone.

Action.—A deficiency of the adrenal cortex hormones results in a condition known as Addison's disease, characterized by a disturbance in the sodium and potassium balance in the body fluids. There is a loss in sodium ion and an in-

crease in potassium ion. The carbohydrate metabolism is altered, the blood sugar level is lowered, and the mechanism which adjusts the body to heat and cold is disturbed. Muscular weakness is present and the pigmentation of the skin is bronzelike.

An excessive secretion of this hormone causes Cushing's disease, characterized by degeneration of the red blood corpuscles.

Desoxycorticosterone is used in the treatment of Addison's disease and in conditions of muscular weakness. It is administered by intramuscular injection and subcutaneous implantation.

Desoxycorticosterone Acetate Pellets.

Thyroid—Thyroideum.—The cleaned, dried, and powdered thyroid gland obtained from domesticated animals used for human food, previously deprived of connective tissue and fat. It contains 0.17 to 0.23 percent of iodine in inorganic or any form of combination other than that peculiar to the thyroid gland. A desiccated thyroid of higher iodine content may be brought to this standard by admixture with a desiccated thyroid of a lower iodine content or with lactose, sodium chloride, starch, or sucrose. Thyroid is a yellowish to buff colored, amorphous powder, having a slight, characteristic, meatlike odor, and a saline taste.

The active constituent is the hormone thyroglobulin, which is an iodine containing globulin, yielding thyroxin upon hydrolysis.

Action.—The primary action of the thyroid is on the metabolic rate, or "calorigenic action." In the presence of thyroid, cells metabolize faster. Thyroid is intimately related to other endocrine glands such as the anterior pituitary, gonads, and parathyroid. A deficiency of secretion may cause such conditions as myxoedema, cretinism, menstrual disorders, and a low basal metabolic rate. Hypersecretion causes exophthalmic or toxic goiter.

Normal thyroid function depends on an adequate intake of iodine. A deficiency may cause excessive growth and enlargement of the gland, or simple goiter. The basal metabolic rate is not lowered. Administration of iodine will prevent occurrence of simple goiter.

Thyroid is used in the treatment of adult and juvenile myxoedema, cretinism, menstrual disorders, obesity (where it should be used with caution), and certain bone and skin diseases. Thyroid is one of the few endocrine glands which is active after oral administration. Dose: 60 mg. (1 grain).

Thyroid Tablets.—Dose: 60 mg. (1 grain).

Parathyroid Injection—Injectio Parathyroidei (Parathroid Solution, Parathyroid Extract).—A sterile solution in Water for Injection of the water soluble principle or principles of the parathyroid glands which have the property of relieving the symptoms of parathyroid tetany and of increasing the calcium content of the blood serum in man and other animals. It is obtained from the fresh parathyroid glands of healthy domesticated animals used as food by man, the animal source of each preparation being stated.

Action.—One cc. of Parathyroid Injection possesses a potency of not less than 100 U. S. P. parathyroid units, each unit representing one one-hundredth of the amount required to raise the calcium content of 100 cc. of blood serum of normal dogs 1 mg. within 16 to 18 hours after administration.

A deficiency of parathyroid secretion will cause a lowering of the blood calcium level and symptoms of calcium deficiency. Parathyroid Injection is employed as a specific in the treatment of this condition. A proper diet is essential during this therapy. It is also used in the treatment of chronic lead poisoning, to aid in the elimination of lead from the bones. Dose: intramuscular, 25 U. S. P. units.

Prophylthiouracil.

Action.—Prophylthiouracil is an antithyroid drug which interferes with the formation of thyroxin by the thyroid gland. It is used in the treatment of hyperthyroidism, thyrotoxicosis, and thyroiditis.

Toxicology.—The toxicity is much less than that of the older drug thiouracil, although there is still some danger in its use. The most serious toxic manifestations are granulocytopenia, leukopenia, drug rash, and fever. Dose: 50 mg. (¾ grain).

Prophylthiouracil Tablets.—Dose: 50 mg. (¾ grain).

Estrogenic Hormone

The estrogenic hormone, or estrin, is present in the follicular fluid. It is a female sex hormone

and is capable of producing sexual activity. It is responsible for the development of sex organs at puberty and for the development and maintenance of secondary sex characteristics. The term "estrogen" does not refer to a specific substance but to a group of compounds having actions in common. These include estrone, estradiol, and stilbestrol. In high concentrations in the body they suppress the activity of the anterior pituitary and inhibit the production of the gonadotrophic hormone. In man, they inhibit the normal function of the testes and many cause abortion. They have a marked effect on calcium metabolism and may cause hypercalcemia.

Estrogens are used in the treatment of menopause, gonorrheal vaginitis in children, senile and juvenile vaginitis, and to suppress lactation.

Estradiol—Estradiol (Dihydrotheelin, Oestradiol).—White or slightly yellow small crystals or crystalline powder, odorless, stable in air, insoluble in water, soluble in alcohol, and sparingly soluble in vegetable oils. It is administered orally. Dose: 0.2 mg. (1/300 grain).

Estradiol Tablets.—Dose: 0.2 mg. (1/300 grain).

Estradiol Benzoate—Estradiolis Benzoas (Oestradiol Monobenzoate).—Dose: intramuscular, 1 mg. (1/60 grain).

Estradiol Benzoate Injection.—Dose: intramuscular, 1 mg. (1/60 grain).

Estrone—Estronum (Theelin).—One of the most active of the estrogens. Dose: intramuscular, 1 mg. (1/60 grain).

Estrone Injection.—Dose: intramuscular, 1 mg. (1/60 grain).

Diethylstilbestrol—Diethylstilbestrol (Stilbestrol).—A synthetic estrogen, more potent than estrone when given orally, less active than estradiol when given parenterally. Dose 0.5 mg. (1/120 grain).

Diethylstilbestrol Capsules.—Dose: 0.5 mg. (1/120 grain).

Diethylstilbestrol Talblets.—Dose: 0.5 mg. (1/120 grain).

Diethylstilbestrol Injection.—Dose: 0.5 mg. (1/120 grain).

Luteal Hormone

Progesterone, the luteal hormone, is present in the corpus luteum, which is normally formed in the second half of the menstrual cycle, after ovulation has occurred. It is present throughout pregnancy. In the absence of pregnancy, the corpus luteum remains functional for about 2 weeks and then retrogresses.

Action.—During pregnancy progesterone prepares the endometrium for the implantation and nourishment of the fertilized ovum, prepares the mammary glands for lactation, and suppresses further ovulation. It is used in the treatment and prevention of spontaneous, habitual, or threatened abortion, in the treatment of functional uterine bleeding, and sometimes in the treatment of dysmenorrhea and amenorrhea.

Progesterone—Progesteronum (proluton, Progestin).—Dose: intramuscular, 5 mg. (1/12 grain). Is prepared synthetically.

Progesterone Injection.—Dose: intramuscular, 5 mg. (1/12 grain).

Ethisterone (Anhydrohydroxyprogesterone, Pranone).—Dose: 10 mg. (1/6 grain).

Ethisterone Tablets.—Dose: 10 mg. (1/6 grain).

Androgens

Androgens are male sex hormones, secreted in the testes. The true testicular hormone is called testosterone. It is necessary for the development of sex organs and the secondary sex characteristics of the male. Androgens are used in the treatment of male climacteric, in the treatment of castrates, and to supress lactation. They are of some value in the treatment of cryptorchidism and pituitary dwarfism. They are administered orally, sublingually, intramuscularly, by innunction, and by subcutaneous implantation.

Testosterone.—It is used in pellet form for tissue implantation. The number of pellets implanted at one time is governed by the need of the patient, which is determined by the response to testosterone propionate by intramuscular injection.

Testosterone Pellets (Oreton F).

Testosterone Propionate—Testosteroni Propionas (Oreton, Perandren, Neohombreol).—Dose: intramuscular, 25 mg. (3/8 grain).

Testosterone Propionate Injection.—Dose: intramuscular, 25 mg. (3/8 grain).

Methyltestosterone—Methyltestosteronum (Oreton-M, Metandren).—Dose: oral. 10 mg. (1/6 grain); sublingual, 5 mg. (1/12 grain).

Methyltestosterone Tablets.—Dose: oral, 10 mg. (1/6 grain); sublingual, 5 gm. (1/12 grain).

Insulin

Insulin Injection.—Injectio Insulini (Insulin, Insulin Hydrochloride).

Action.—Insulin is the hormone secreted by the islands of Langerhans in the pancreas. It controls the oxidation of carbohydrates and the blood sugar level. A deficiency will cause a rise in blood sugar and other symptoms that characterize diabetes mellitus. The disease can be controlled by injections of insulin, in conjunction with a strict diet. Hyperinsulinism usually occurs from an overdose of insulin. The blood sugar level is lowered, resulting in such symptoms as hunger, weakness, sweating, staggering, double vision, and rarely convulsions, coma, and death.

Insulin is used in the treatment of diabetes mellitus and diabetic coma; and in cases of impaired nutrition, to increase the weight of the patient; in the treatment of schizophrenia by producing insulin shock.

Protamine Zinc-Insulin Injection.—Protamine insulin is slower of absorption than plain insulin and is preferred in most cases.

Globin Zinc Insulin Injection.—An almost clear colorless liquid. It is insulin modified by the addition of globin hydrochloride and zinc chloride. The product is intermediate between insulin and protamine zinc insulin in its onset and duration of action. It should never be mixed with protamine zinc insulin.

VITAMINS

Vitamins are a group of accessory organic substances existing in most foods in minute amounts in their natural state, which are needed in the diet for metabolism. Their absence results in malnutrition and specific deficiency diseases. Their chemistry is complex and nutritional experimentation is difficult, so our knowledge of them is being continually supplemented and revised. Vitamins A and E each contain two distinct factors and vitamin B has been fractioned into several factors. It is quite possible that additional vitamins will be discovered or that some of those already recognized may prove to contain more than one factor.

Vitamins are so widely distributed in foods that a normal diet usually provides an adequate amount. Some are destroyed by the preparation or preservation of certain foods, and as a result the diet needs to be supplemented with specific vitamins. Some manufacturers add vitamins to their products to replace those destroyed or removed in processing.

Vitamin A.—Vitamin A is present in fish liver oils, liver, butter, eggs, cream, yellow vegetables, and fruits. In butter, cream, eggs, and carrots, both Vitamin A and provitamin A (Carotene) may be present. Provitamin A is capable of being changed into Vitamin A.

Vitamin A is used to remedy such deficiency conditions as night blindness, xerophthalmia, and keratosis of the skin. The daily requirement for a healthy adult is about 5,000 U. S. P. units and for growing children about 6,000 to 8,000 units.

Oleovitamin A (Natural Vitamin A in oil).

Oleovitamin Vitamin Capsules.—Dose: daily prophylactic, 5,000 units.

Vitamin B Complex—Vitamin B Complex.—Vitamin B Complex consists of a number of factors, some of which have been identified and synthesized. It is less stable than vitamin A, although some of its constituents can withstand heat for a short time. The best natural sources are rice polishings, yeast, and liver. Other good sources include fruits, meat, milk, and eggs.

Thiamin (Vitamin B_1).—This was the first recognized constituent of vitamin B complex to be isolated in crystalline form. It is the antineuritic vitamin which prevents beri-beri and polyneuritis. It is used as a specific for the prevention and treatment of beri-beri. It may also be used in cases of lack of appetite because of dietary disturbance. An increase in Thiamin may be necessary in cases of increased metabolism, as in hyperthyroidism or fevers. The normal daily requirement is 1 to 2 mg.

Thiamin Hydrochloride.

Thiamin Hydrochloride Injection.

Thiamin Hydrochloride Tablets.

Rice Polishings Extract.—Dose: 8 cc. (2 fluidrachms).

Riboflavin (Vitamin B_2, Vitamin G, Lactoflavin).—A deficiency of this vitamin causes pellagra, and its principal use is in the treatment of this disease. Improvement occurs within 24 hours. The average daily requirement is 10 to 40 mg.

Riboflavin Injection.

Riboflavin Tablets.

Nicotinic Acid (Niacin).—A white crystalline powder, soluble in water and alcohol.

Action.—Nicotinic acid and the amide are important in the treatment of pellagra. Large doses of Nicotinic Acid produce flushing of the face and neck; this reaction being harmless. It is not observed when nicotinamide is used. Dose: 25 mg. (3/8 grain).

Nicotinic Acid Tablets.—Dose: 25 mg. (3/8 grain).

Nicotinic Acid Capsules (Niacin Capsules).—Dose: 25 mg. (3/8 grain).

Nicotinamide—(Niacinamide).—This is the amide of Nicotinic Acid and has the same uses. Dose: oral, 25 mg. (3/8 grain); parenteral, 100 mg. (1½ grains).

Nicotinamide Capsules (Niacinamide Capsules).—Dose: 25 mg. (3/8 grain).

Nicotinamide Injection (Niacinamide Injection).—Dose: 100 mg. (1½ grains).

Nicotinamide Tablets (Niacinamide Tablets).—Dose: 25 mg. (3/8 grain).

Pyridoxine (Vitamin B_6).—Chemically it is a derivative of pyridine. It appears to be associated with certain neuromuscular conditions and with the utilization of fatty acids, but its value in the treatment of human disease is not yet clearly established. It has been used in the treatment of palsy, muscular atrophy and weakness, agranulocytic angina, and in combination with thiamin to overcome nausea and vomiting in pregnancy. The daily requirement of the normal adult is about 2 mg. It is used in the form of the hydrochloride, as injectable solutions or tablets.

Rutin—Rutinum.—Dose: 20 mg. (1/3 grain).

Rutin Tablets.—Dose: 20 mg. (1/3 grain).

Vitamin B_{12} (Be-Dodec, Betalin 12, Cobione, Bevidox Crystalline, Rubramin, Dodecavite Crystalline).—A cobalt-containing substance produced by the growth of suitable microbial organisms or obtained from liver. It is a dark red crystalline substance, somewhat soluble in water. It is believed to be the true anti-pernicious anemia factor. Dose: intramuscular or subcutaneous, daily requirement, 1 microgram, usually administered in 10 to 15 microgram doses at intervals.

Vitamin B_{12} Injection.—Dose: Same as Vitamin B_{12}.

Pantothenic Acid—A member of vitamin B complex.—It is also known as the "filtrate" factor and the "chick antidermatitis" factor. Laboratory experiments show that black rats on a Pantothenic Acid deficient diet turn gray and show poor growth, dermatitis, and adrenal hemorrhage. This is not the only antigraying factor, as biotin and inositol share this property, and it is not involved in the graying of hair in human beings. A deficiency of Pantothenic Acid in chicks may cause dermatitis. Clinical observations indicate that this factor is necessary in human nutrition. The average daily requirement is 3 to 4 mg. It is marketed as the calcium salt.

Para-Aminobenzoic Acid (Paba).—A member of the vitamin B complex, which is necessary for normal pigmentation of hair and maintenance of coat in the rat, growth in the chick, and multiplication of certain strains of bacteria. Its action in the human body is not clear. It is used to increase the blood level of streptomycin and salicylates. It has been used recently with encouraging results in the treatment of diseases caused by Rickettsia, such as scrub typhus, louse-borne typhus, and Rocky Mountain spotted fever. Dose: 10 gm. (2½ drachms).

Para-Aminobenzoic Acid Tablets.—Dose: 10 gm. (2½ drachms).

Choline.—This member of vitamin B complex is a constituent of lecithin and is chemically associated with acetylcholine. A deficiency in the diet of a mammal gives rise to fatty degeneration of the liver and kidney. It has been used effectively in the treatment of hepatitis and cirrhosis of the liver.

Folic Acid.—This factor of vitamin B complex is present in liver, kidney, yeast, and green leaves. It was found necessary for the growth of the Lactobacillus casei and was designated as the "L. casei factor." It was also called vitamin M because its deficiency caused retarded growth, loss of growth, and leukopenia in monkeys, and vitamin Bc because its deficiency in chicks caused macrocytic hypochromic anemia.

Folic Acid has been prepared synthetically. Chemically it is called pteroyl glutamic acid. It has been used very successfully in the treatment of tropical sprue and nutritional, pernicious, and other forms of macrocytic anemia. Its use in leukopenia has also been suggested. Dose: daily, 10 mg. (1/6 grain).

Folic Acid Capsules.—Dose: daily, 10 mg. (1/6 grain).

Folic Acid Tablets.—Dose: daily, 10 mg. (1/6 grain).

Ascorbic Acid—Acidum Ascorbicum, Vitamin C, (Cevitamic Acid).—It exists as two isomers, levo-ascorbic acid, which is the active substance, and dextro-ascorbic, which is physiologically inert. Ascorbic Acid is present in potatoes, citrus fruits, green vegetables, tomatoes, and strawberries. A deficiency causes scurvy and is believed to delay healing of wounds. The average daily requirement is 30 to 75 mg.

Ascorbic Acid Injection.

Ascorbic Acid Tablets.

Sodium Ascorbate Injection.—Dose: 0.1 gm. (1½ grains).

Vitamin D.—It is often called the antirachitic vitamin. It is fat soluble and is present in fish liver oils, egg yolk, milk, and butter. It affects the absorption and utilization of calcium and phosphorus in the body and is used in the prophylaxis and treatment of rickets in children and softening of the bone in adults. It has some relationship with the functions of the thyroid and parathyroid glands. An excessive intake of Vitamin D causes a decrease in the amount of calcium and phosphate in the intestinal contents and overcalcification at the growing ends of the bones. The average daily requirement is 400 units.

Synthetic Oleovitamin D.

Calciferol (Viosterol, Vitamin D_2).—This is pure vitamin D_2, made by the irradiation of ergosterol. A white crystalline substance, insoluble in water.

Activated 7-Dehydrocholestrol (Vitamin D_3).—It is activated by the irradiation of 7-dehydrocholestrol with ultraviolet light or its activation with cathode rays.

Vitamin E (Alpha-Tocopherol).—Little is known about the metabolism of this vitamin. Studies show that it is essential for the normal function of the nuclei of all animal cells. It is poorly stored in the body. A deficiency in the male caused degeneration of the testes, and the spermatozoa were nonmotile. In the female, the development of the fetus was retarded after normal implantation had occurred, and death and resorption of the embryo followed. Experiments show that Vitamin E deficiency interferes with the balance between the gonadotrophic hormone in the anterior pituitary and the hormones produced by the gonads and also affects the skeletal muscles, resulting in spastic paralysis or muscular weakness.

Vitamin E has been used in cases of sterility and habitual abortion and in muscular weakness and atrophy, but there is little evidence of its value. It is found in wheat germ oil, cottonseed oil, green leafy vegetables, meat, and eggs.

Vitamin K.—(Menadione, Menadione Sodium Bisulfite) is the factor necessary for the maintenance of the normal prothrombin level in the blood. Prothrombin is essential for clotting of the blood. The normal prothrombin level is dependent not only on an adequate amount of Vitamin K, but also on the presence of bile and normal bacteria flora in the intestinal tract, normal absorptive activity of the intestinal mucosa, and the presence in the liver of a sufficient number of active cells, which are necessary for the synthesis of prothrombin from Vitamin K.

Vitamin K is used in the treatment of obstructive jaundice and in biliary fistulae, where there is a tendency to hemorrhage because of a deficiency of prothrombin in the blood. It is also administered during labor, as a prophylaxis against hemorrhage in the newborn, and in the treatment of physiological hypothrombinemia of the newborn. The average daily requirement for the newborn is about one microgram.

Menadione Capsules.

Menadione Injection.

Menadione Tablets.

Menadione Sodium Bisulfite.—Dose: intramuscular or intravenous, 2 mg. (1/30 grain).

COMMON POLYVITAMIN PREPARATIONS

Cod Liver Oil.—Contains Vitamin A and D. Dose: daily, 8 cc. (2 fluidrachms).

Cod Liver Oil Emulsion.—Dose: daily 15 cc. (4 fluidrachms).

Cod Liver Oil Emulsion With Malt.—Dose: daily, 15 cc. (4 fluidrachms).

Non-Destearinated Cod Liver Oil.

Halibut Liver Oil.—Dose: daily, prophylactic, 0.1 cc. (1½ min.).

Halibut Liver Oil Capsules.—Dose: daily, prophylactic, 1 capsule containing 5,000 units vitamin A.

Oleovitamin A and D.—Dose: daily, 8 cc. (2 fluidrachms).

Concentrated Oleovitamin A and D.—Dose: to be determined according to the needs of the patient.

Concentrated Oleovitamin A and D Capsules.—Dose: daily, prophylactic, 1 capsule.

Dried Yeast (Brewer's Yeast).—Contains Thiamin Hydrochloride, Riboflavin, and Nicotinic Acid. Dose: according to the needs of the patient.

Dried Yeast Tablets (Brewer's Yeast Tablets).—Dose: according to the needs of the patient.

Hexavitamin Capsules (Multiple Vitamin).—Contains in each capsule 5,000 units of Vitamin A, 400 units of Vitamin D, 75 mg. of Ascorbic Acid, 2 mg. of Thiamine Hydrochloride, 3 mg. of Riboflavin, and 20 mg. of Nicotinamide. Dose: according to the needs of the patient.

Hexavitamin Tablets.

Triasyn B Capsules.—Contains in each capsule 2 mg. of Thiamin Hydroxide, 3 mg. Riboflavin, 20 mg. Nicotinamide.

Triasyn B Tablets.

COAGULANTS AND ANTICOAGULANTS

The coagulation of blood consists in the transformation of the dissolved fibrinogen of the circulating blood into insoluble fibrin by the action of thrombin. Fibrinogen is an acid globulin, formed exclusively in the liver. Thrombin is a protein not contained in the circulating blood, but formed from prothrombin by the action of thrombokinase, which requires the calcium ion in the blood. Thrombin converts 2,000 times its weight of fibrinogen into fibrin. The prevention of coagulation is due to the continuous production of several antisubstances, especially antithrombin, associated with the albumin fraction, which prevents the action of thrombin on fibrinogen, and antiprothrombin, which keeps prothrombin in inactive combination.

The addition of citrate or oxalate to shed blood prevents coagulation by inactivating the calcium.

COAGULANTS

Oxidized Cellulose.—A form of cotton or gauze, slightly acid to taste; soluble in dilute alkalis but insoluble in acids or water. It is used as a surgical hemostatic agent, acting as an artificial clot.

Absorbable Gelatin Sponge.—A sterile, absorbable, water insoluble gelatin base sponge. It is used as a hemostatic agent, when saturated with sterile normal saline solution or a thrombin solution. It may be left in the body since it is slowly absorbed.

Thrombin—(Thrombol).—A sterile protein substance prepared from prothrombin of mammalian origin and thromboplastin in the presence of calcium. It is a white or grayish white, amorphous substance. Before use it is added to sterile normal saline solution, which can be applied topically to arrest capillary bleeding.

Antihemophilic Globulin.—A white or nearly white amorphous substance dried from the frozen state. It is restored with a normal saline solution or sterile water. It is used to shorten the clotting time of hemophilic blood. Dose: intravenous, 200 mg. protein.

ANTICOAGULANTS

Bishydroxycoumarin.—(Dicoumarol, Dicoumarin).

Action.—It is used as an anticoagulant, acting by interfering with prothrombin formation in the liver. It does not produce an immediate effect. Whole blood transfusions and large doses of high potency K-active substance should be given if the prothrombin level drops below 15 percent of normal. This drug should not be employed without the facilities of laboratory control to follow the level of blood prothrombin.

Bishydroxycoumarin Tablets.

Bishydroxycoumarin Capsules.

Heparin Sodium (Heparin).—A mixture of active principles obtained from the liver or lungs of domesticated animals.

Action.—It acts as antiprothrombin and antithrombin in the blood stream, prolonging the clot-

ting time of blood. It is used in the prophylaxis and the treatment of thrombosis, both postoperative and during transfusion. It is usually given by subcutaneous or continuous intravenous injection.

Heparin Sodium Injection.

DIAGNOSTIC AGENTS

Barium Sulfate—Barii Sulfas, $BaSO_4$.—**Caution:** When Barium Sulfate is prescribed, the title should always be written out in full to avoid confusion with the poisonous barium sulfide or barium sulfite.

Barium Sulfate is employed in roentgenography for X-rays of the gastrointestinal tract. It is usually administered in water or with a mucilaginous substance. It is opaque to X-rays.

Toxicology of soluble barium salts.—The symptoms are burning pain in the stomach, nausea, vomiting, diarrhea, vertigo, and ringing in the ears, slow and irregular pulse, and possible convulsions. Death may occur in 1 hour or be delayed for some time.

Treatment of the chemical antidote, magnesium or sodium sulfate.

Gastric lavage, symptomatic treatment.

Iodophthalein Sodium. — Iodophthaleinum Sodicum (Soluble Iodophthalein, Tetraiodophthalein Sodium).

Action.—It is used as a diagnostic agent to test the excretory function of the liver and to render the gallbladder opaque to X-ray. Its use in liver tests depends on the fact that when the liver is normal, the dye is eliminated from the blood chiefly through that organ. It is administered either orally or intravenously. All solution for injection should be freshly prepared. Dose: For each 10 kg. of body weight, oral, 0.5 gm. (7½ grains); intravenous, 0.3 gm. (5 grains).

Sulfobromophthalein Sodium—Sulfobromophthaleinum Sodicum.—It is used to test the functional activity of the liver, being considered more reliable than iodophthalein. It is administered by injection. Dose: For each kilogram of body weight, intravenous, 2 mg. (1/30 grain).

Sulfobromophthalein Sodium Injection.—Dose: intravenous, for each kg. of body weight, 2 mg. (1/30 grain).

Phenolsulfonphthalein — Phenolsulfonphthaleinum (Phenol Red).—It is used in renal function tests. It is administered intramuscularly or intravenously. The official injection is prepared by using sodium bicarbonate or sodium hydroxide as a solvent. Dose: intravenous or intramuscular, 6 mg. (1/10 grain).

Phenolsulfonphthalein Injection.

Iodopyracet Injection—Injectio Iodopyraceti (Diodrast Sterile Solution).—Used as a contrast medium in intravenous urography.

Congo Red.—A dark red or reddish brown powder, soluble in water and slightly soluble in alcohol.

Congo Red Injection.—It is used in the diagnosis of amyloidosis.

Action.—Injected intravenously into normal subjects, it is retained in the blood stream much longer than when injected into the blood stream of a patient with type II nephritis and amyloidosis. In the case of type II nephritis, the dye passes through the kidney into the urine. In amyloidosis the dye is absorbed by the amyloid tissues.

Iodoalphionic Acid.

Action.—It is given orally for the delineation of the gallbladder in cholecystography. The patient is directed to eat a light, fat-free meal on the afternoon of the day preceding the examination. It should not be given patients having nephritis, uremia, or acute gastrointestinal disorders. Dose: 3 gm. (45 grains).

Iodoalphionic Acid Tablets (Priodax Tablets).—Dose: 3 gm. (45 grains).

Methiodal Sodium (Skiodan).—It is used for intravenous urography and retrograde pyelography.

Methiodal Sodium Injection.

Sodium Iodomethamate (Neo-Iopax).—Used as a contrast medium in intravenous urography and retrograde pyelography. Dose: intravenous, 10 gm. (2½ drachms).

Sodium Iodomethamate Injection.

Iodized Oil—Oleum Iodatum.—Used as a contrast medium in roentgenography.

Fluorescein Sodium—Fluoresceinum Sodicum (Soluble Fluorescein, Resorcinolphthalein Sodium).—Used as a diagnostic agent in ophthalmology to delineate corneal ulcerations and foreign bodies. When a solution is applied to the cornea,

ulcerated areas are stained green, foreign bodies appear surrounded by a green ring, loss of substance in the conjunctiva is shown by a yellow stain.

INSECT REPELLENTS

Butopyronoxyl (Indalone).—Used as an insect repellent.

Dimethyl Phthalate.

Compound Dimethyl Phthalate Solution.—It is used as an insect repellent, being applied to the skin. It is somewhat irritating to mucous membrane, and care must be taken not to get it into the eyes.

Ethohyxadeil (Rutgers 612).—It is an ingredient of Compound Dimethyl Phthalate Solution.

POISON ANTIDOTES

Dimercaptol (BAL).

Dimercaptol Injection (BAL Injection).—A sterile 10 percent solution of Dimercaptol in oil.

Action.—It is a valuable antidote for heavy metal poisoning, particularly useful in treating acute and chronic posioning due to mercury, arsenic, and lead. Its action is based on the formation of a stable compound with heavy metals by reason of the affinity between the metals and the sulfhydryl groups of the Dimercaptol.

FLAVORING AGENTS

Sweet Orange Peel—Aurantii Dulcis Cortex.—The fresh outer rind of the nonartificially colored ripe fruit of Citrus sinensis (Fam. Rutaceae). The inner, white portion of the rind should be excluded.

Sweet Orange Peel Tincture—50 percent.

Orange Oil (Sweet Orange Oil).

Compound Orange Spirit.

Orange Syrup.

Aromatic Elixir.

Red Aromatic Elixir.

Isoalcoholic Elixir.

Bitter Orange Peel—Aurantii Amari Cortex.—The dried rind of the unripe fruit of Citrus Aurantium (Fam. Rutaceae).

Bitter Orange Peel Tincture.

Bitter Orange Elixir.

Orange Flower Oil (Neroli Oil).—The volatile oil distilled from the fresh flowers of Citrus Aurantium.

Orange Flower Syrup.

Orange Flower Water (Stronger Orange Flower Water).

Bitter Almond Oil—Oleum Amygdalae Amarae (Oil of Bitter Almond).—**Caution:** Bitter Almond Oil is intended for medicinal use and should not be used for flavoring foods.

Lavender Oil (Lavender Flowers Oil).—The volatile oil distilled with steam from the fresh flowering tops of Lavandula Officinalis.

Lavender Spirit.

Compound Lavender Tincture (Compound Lavender Spirit).

Lemon Peel—Limonis Cortex.—The outer, yellow rind of the fresh, ripe fruit of Citrus Limon (Fam. Rutaceae).

Lemon Oil.

Lemon Tincture (Lemon Peel Tincture).

Myristica—Myristica (Nutmeg).—The dried, ripe seed of Myristica fragrans, deprived of its seed coat and arillode, and with or without a thin coating of lime. It has an aromatic odor and a pungent, aromatic taste.

Myristica Oil.

Coriander—Coriandrum (Coriander-seed).—The dried, ripe fruit of Coriandrum sativum (Fam. Umbelliferae); yields about 0.25 cc. of volatile oil from each 100 gm. of the drug.

Coriander Oil.

Fennel — Foeniculum (Fennelseed). — The dried, ripe fruit of the cultivated varieties of Foeniculum vulgare (Fam. Umbelliferae). Dose: 1 gm. (15 grains).

Fennel Oil.

Fennel Water.

Sassafras—Sassafras.—The dried bark of the root of Sassafras albidum; yields about 4 cc. of sassafras oil from each 100 gm. of drug.

Sassafras Oil.

Benzaldehyde—Benzaldehydum, $C_6H_5.CHO$.—A colorless liquid having an odor of bitter almond oil and a burning, aromatic taste. Dose: 0.03 cc. (½ min.).

Compound Benzaldehyde Elixir.

Benzaldehyde Spirit.

Wild Cherry—Prunus Virginiana (Wild Black Cherry Bark).—The stem bark of Prunus sero-

tina (Fam. Rosaceae), collected in autumn and carefully dried. Borke, if present, should be removed. It contains a glucoside, d-mandelnonitrile and a ferment, emulsin. When the bark is moistened with tepid water, benzaldehyde and a small amount of hydrocyanic acid are formed.

It is used chiefly as a flavor for cough syrups.

Wild Cherry Syrup.

Wild Cherry Fluidextract—Dose: 2 cc. (30 min.).

Vanilla—Vanilla (Vanilla Bean).—The cured, full-grown, unripe fruit of Vanilla, planifolia, (Mexican or Bourbon Vanilla), or of Vanilla tahitensis (Tahiti Vanilla) (Fam. Orchidaceae).

Vanilla Tincture.

Vanillin.—Fine white or slightly yellow needle-like crystals, having an odor and taste suggestive of vanilla.

Compound Vanillin Elixir.

Compound Vanillin Spirit.

Cacao—Cacao (Cocoa).—The powder prepared from the roasted, cured kernels of the ripe seed of Theobroma Cacao (Fam. Stericuliaceae).

Cacao Syrup (Chocolate-flavored Syrup).

Cherry Juice—Succus Cerasi.—The liquid expressed from the fresh, ripe fruit of Prunus Cerasus.

Cherry Syrup.

Raspberry Juice—Succus Rubi Idaei.—The liquid expressed from the fresh, ripe fruit of varieties of Rubus idaeus or Rubus strigosus (Family Rosaceae).

Raspberry Syrup.

Spearmint—Mentha Viridis (Garden Mint).—The dried leaves and flowering tops of Mentha spicata.

Spearmint Oil.

Spearmint Spirit (Essence of Spearmint).—Dose: 1.0 cc. (15 minums).

Spearmint Water.

Sarsaparilla.—The dried root of Smilax Aristolochiaefolia or Regelii or other species of Smilax. It is nearly odorless and has a mucilaginous, somewhat sweet and acrid taste.

Sarsaparilla Fluid Extract.

Compound Sarsaparilla Syrup.

Saccharin (Gluside, Benzosulfimide).—White crystals or crystalline powder. Soluble, 1 gm. in 290 cc. water and 31 cc. of alcohol. A 60 mg. portion of saccharine has sweetening power equivalent to about 30 gm. of sucrose.

Saccharin Sodium (Soluble Saccharin).—Soluble, 1 gm. in 1.5 cc. water and 50 cc. alcohol.

COLORING AGENTS

Amaranth—Amarzuthum (F. D. & C. Red No. 2).—A dark. red brown powder, soluble in 15 parts water and very slightly soluble in alcohol.

Amaranth Solution.

Compound Amaranth Solution.

Carmine—Carminum.—The aluminum lake of the coloring principle obtained from cochineal; vivid red powder or angular, irregular fragments, odorless and tasteless. It colors solutions red.

Carmine Solution.

Cochineal—Coccus.—The dried female insects of Coccus Cacti (Family Coccidae) enclosing the young larvae; irregularly oval grains about 4 cm. in diameter, of a grayish to purplish color. The coloring principle is carminic acid, which yields a brilliant crimson color, becoming orange in acid solution and purplish in alkaline.

Cochineal Solution.

Red Saunders—Santalum Rubrum.—The heart wood of Pterocarpus santalinus (Family Leguminosae); a purplish to reddish-brown, coarse powder or chips.

It is used to impart color to alcoholic solutions.

Caramel—Carmel (burnt sugar coloring).—A concentrated aqueous solution of the product obtained by heating sucrose or glucose until the sweet taste is destroyed and a uniform dark brown mass results, a small amount of alkali, alkaline carbonate, or mineral acid being added while heating. It is a thick, dark brown liquid, with a burnt sugar odor and a pleasant, bitter taste.

SOLVENTS

Acetone—Acetonum, $CH_3.CO.CH_3$ (Dimethyl Ketone).—Causes toxic symptoms similar to those produced by alcohol.

Petroleum Benzin—Benzinum Petrolei (Petroleum Ether).—A purified distillate from petroleum, consisting of hydrocarbons, chiefly of

the methane series. It is highly flammable, and and its vapor, when mixed with air and ignited, may explode. It is a clear, colorless, volatile liquid, having an etheral or faint petroleum-like odor. It is insoluble in water, miscible with ether, chloroform, and fixed and volatile oils, and freely soluble in alcohol.

It is used as a solvent for fats.

Propylene Glycol.—A clear, colorless, viscous liquid, miscible with water. It is used as a substitute for glycerin.

Isopropyl Alcohol (Isopropanol).—A colorless, mobile, volatile liquid with a characteristic odor and bitter taste. It is used as a solvent for extracting drugs.

SURFACE ACTIVE AGENTS

Polysorbate 80 (Tween 80).—A lemon to amber colored, oily liquid, soluble in water and alcohol. It is used in pharmacy as an emulsifying agent.

Dioctyl Sodium Sulfosuccinate (Aerosol OT dry).—A white, waxlike plastic solid having a characteristic odor. It is very soluble in alcohol and soluble, 1 gram in 70 cc. of water. It is used as an emulsifying and wetting agent.

Hydroxystearin Sulfate (SHCA, Sulfated hydrogenated castor oil).—A pale yellow-brown, semisolid mass with a faint odor. It is used as an emulsifying agent.

Sodium Lauryl Sulfate (Duponol C, Irium, Gardinol WA).—A mixture of sodium alkyl sulfates; occurs as small white crystals with a characteristic odor. It is soluble, 1 gm. in 10 cc. of water. It is used as an emulsifying, detergent, and wetting agent.

Stearyl Alcohol (Stenol).—A mixture of solid alcohols; occurs as white unctuous flakes or granules, insoluble in water. It is used as an emulsifying agent.

Medicinal Soft Soap (soft soap, green soap).—A potassium soap made by the saponification of vegetable oils without removing the glycerin. A soft, unctuous, yellowish brown to greenish yellow translucent mass with a slight characteristic odor.

Soft Soap Liniment (tincture of green soap).

Compound Soft Soap Liniment (compound green soap tincture).

Chapter VIII

PHARMACY

Pharmacy is the science which treats of medicinal substances including the art of preparing and dispensing them, their identification, selection, preservation, combination, analysis, and standardization.

There are two official books used by the pharmacist, the Pharmacopoeia of the United States of America and the National Formulary. Official books are those which are endowed by law with legal authority. They are enforced pharmaceutical standards, which became official by the Food and Drugs Act of 1906.

The United States Pharmacopoeia (U. S. P.) first appeared in 1820 by authority of the medical schools and colleges. It is now revised and published every 5 years by the United States Pharmacopoeial Convention. The Convention is composed of delegates appointed from a complete representation of the professions of medicine, dentistry, pharmacy, and chemistry. The Pharmacopoeia is restricted to those drugs and preparations which have stood the test of modern research and continued use.

The Pharmacopoeia contains the following information regarding drugs or preparations listed:

1. Official English title.
2. Official Latin title.
3. Abbreviated title.
4. Synonym.
5. Botanical name (for plants).
6. Symbolic formula (for chemicals).
7. Structural formula (for organic chemicals).
8. Official definition.
9. *Purity rubric.*—This term indicates the quantity of impurity allowed by giving the percentage of pure substance that must be present.
10. *Official description and physical properties.*—For the vegetable drugs, this is a statement of their physical characteristics. For the chemicals, the description includes the symbolic formula, rubric, and description, and also the solubility.
11. Test for purity and identity.
12. *Assays.*—Chemicals, preparations, and certain crude drugs have assays which are intended to insure the contents as stated in the purity rubric.
13. *Storage.*—The storage specifications are given to maintain the activity of the drug or preparation for a maximum period of time.
14. Alcohol content.
15. *Preparations.*—When the pharmacopoeial substance is used in the manufacture of other pharmacopoeial preparations, the preparations are listed.
16. *Doses.*—The doses are listed as the average doses and are given in the metric and apothecary system.

The National Formulary (N. F.) is revised and published every 5 years by the American Pharmaceutical Association. It contains a list of drugs or preparations, most of which have been deleted from the Pharmacopoeia but which are used sufficiently by physicians to deserve recognition in a publication other than the Pharmacopoeia. The nomenclature of the National Formulary is the same as that of the Pharmacopoeia.

New and Nonofficial Remedies (N. N. R.) is a book published by the Council on Pharmacy and Chemistry of the American Medical Association. It lists and describes the drugs that have been accepted by the council. The descriptions of the accepted drugs are based in part on investigation made by, or under the direction of, the council, and in part on evidence or information supplied by the manufacturer. Statements made by those commercially interested are examined critically and the drug is admitted only when such statements are supported by other evidence or when they conform to known facts.

A dispensatory is a commentary on the Pharmacopoeia and the National Formulary and includes complete information on all drugs listed in the Pharmacopoeia.

WEIGHT AND VOLUME

It is convenient and customary to speak of amounts of liquids as volumes and amounts of solids as weight, although some liquids, such as acids, chloroform, ether, and glycerin, are bought and sometimes used by weight.

Weight is the measurement of gravity on a quantity of matter. The gravitating force of the earth varies at different points on the earth's surface, so the weight of a certain quantity of matter will vary with the gravitating force. The correct term for a definite quantity of matter is mass.

When we determine the weight of a substance in pharmacy, we are measuring the mass, because we compare the substance to be weighed with standards which we call weight, and the effect of gravity does not change the measurement. Three systems of weights are used in pharmacy: metric, avoirdupois, and apothecary. The metric is the official system used by the Navy. The avoirdupois system is used in commercial transactions, and the apothecary system is used only in filling prescriptions. The avoirdupois weights are usually made of iron. The apothecaries and metric weights are made of brass or nickle-plated brass; the smaller ones, like the grain weights in the apothecaries weights and those below the gram in the metric system, are usually made of aluminum.

Balances vary considerably in construction and accuracy. For less accurate work, when quantities as great as 10 pounds are to be weighed, a counterbalance is used. It is constructed like a prescription balance, but it is larger and of stronger construction. It has a sensitivity of about 5 grains. For the most accurate work, analytical balances are used.

A good prescription balance should be constructed with the two arms of the beam equal in length. This may be tested by interchanging balanced weights without changing the balance. The pans should be properly suspended and tested by changing the position of balanced weights to various areas on the pans without changing the balance. The balance should be accurate to within 2 mg. It should be kept in a room as free as possible from vibration, dust, and moisture, with a temperature as even as possible, and it should be protected from corroding vapors. Fuming liquids should be weighed in well-stoppered bottles. The substances to be weighed should not be placed directly on the pans. Glass scale pans or papers should be placed on the pans before weighing. Weights should never be left on the pans and should always be handled with forceps, as contact with the fingers will cause them to corrode. The balance should not be allowed to oscillate after weighing, and during weighing it should be brought to a state of rest whenever weights or substances being weighed are added or removed.

Volume is the space occupied by a mass.

The accuracy of a measuring instrument depends on the surface area of the liquid. The accuracy is increased as the surface area is decreased. It is not possible to pour all the liquid from a vessel, so a distinction must be made between receiving capacity and delivery capacity. The delivery capacity is the true capacity, taking into account the amount which adheres to the vessel when the liquid is poured out. Many volumetric flasks and pipettes show both receiving and delivery capacities. The official specifications for volumetric apparatus are stated in the U. S. P.

WEIGHTS AND MEASURES

Metric System

The units of standard for the metric system are meter (the standard of length), kilogram (the standard of weight), and liter (the standard of volume). The meter is the distance measured under specified conditions between two designated lines upon the prototype platinum-iridium bar located at the International Bureau of Weights and Measures. The kilogram is the weight which, when weighed under specified conditions, is equivalent to that of the prototype kilogram which is a platinum-iridium cylinder kept at the International Bureau of Weights and Measures. The liter is the volume of 1 kilogram of water, when weighed under specified conditions, based on the prototype kilogram.

The metric system is the only system of weights and measures having a unit of weight equal to a unit of volume for a common standard such as water. A convenient feature of the metric system is that the various units of its measurements are in decimal progression, so that 10 units of one size make one of the next higher, 10 of which make one of the next higher, and so on.

The names in the metric system are formed by joining certain Greek prefixes for denominations above the meter, liter, or gram, and certain Latin prefixes for denominations below these units. These prefixes are:

Greek		Latin	
deka	ten (10)	deci	tenth (1/10)
hecto	hundred (100)	centi	hundredth (1/100)
kilo	thousand (1,000)	milli	thousandth (1/1000)

Metric Tables of Weights and Measures

Linear (meter)	Volume (liter)	Weight (gram)
Kilometer (Km.)	Kiloliter (Kl.)	Kilogram (Kg.)
Hectometer (Hm.)	Hectoliter (Hl.)	Hectogram (Hg.)
Dekameter Dm.)	Dekaliter (Dl.)	Dekagram (Dg.)
Meter (M)	Liter (L.)	Gram (gm.)
Decimeter (dm.)	Deciliter (dl.)	Decigram (dg.)
Centimeter (cm.)	Centiliter (cl.)	Centigram (cg)
Millimeter (mm.)	Milliliter (ml.)	Milligram (mg.)

The term cubic centimeter (cc.) is also used for milliliter (ml.). It is $\frac{1}{1000}$ part of a liter, and 1 cc. or ml. of water weights 1 gm. when weighed in vacuo at 4° C.

Apothecaries System

The apothecaries system of weight is used only in writing and compounding prescriptions. The smallest unit is the grain (gr.) which is equal in weight to 64.79 mg.

APOTHECARIES TABLE OF WEIGHTS

20 grains (gr.)	1 scruple ℈.
3 scruples	1 drachm (ʒ) (60 gr.).
8 drachms	1 ounce (℥) (480 gr.).
12 ounces	1 pound (lb) (5,760 gr.).

APOTHECARIES TABLE OF FLUID MEASURES

60 minims (♏)	1 fluidrachm (*f*ʒ).
8 fluidrachms	1 fluidounce (*f*℥) (480♏).
16 fluidounces	1 pint (O) (7,680♏).
8 pints	1 gallon (Cong.) (128 *f*℥).

The primary unit is the gallon which is defined as the volume of 3,785.33 ml. or 3,785.33 gm. of water. One minim of water weighs 0.947 grain and has a volume of 0.061 ml. One fluidounce of distilled water at 25° C., which is normal room temperature, weighs 454.6 grains. This weight is frequently used in pharmaceutical calculations.

Many physicians omit the *f*, using only ʒ for *f*ʒ, and ℥ for *f*℥. Since liquids are measured and solids are weighed, the ʒ and ℥ stand for *f*ʒ and *f*℥, respectively, in the case of liquids, and for the weight units in case of solids.

Avoirdupois System

Most weighable merchandise, except gems and precious metals are bought and sold in the United States by avoirdupois weight. Some chemicals and drugs are bought by the metric system, but the metric system has not as yet been adopted for everyday commercial transactions. It should be distinctly understood that in the United States all drugs and chemicals which are not bought and sold by metric weight are bought and sold by avoirdupois weight. The apothecaries weight is never used in commercial transactions, not even in the case of the most costly plant principles. An ounce of morphine or quinine contains 437.5 grains; one eighth of an ounce of aconitine contains one-eighth of 437.5 grains. So when narcotics are taken up on the pharmacy books when received from the medical storeroom, they are taken up in the case of 1 ounce, as 437.5 grains, and in the case of one-eighth ounce as 84.7 grains.

The units of the avoirdupois system of weight are defined in terms of metric weights. The smallest unit, the grain, is equivalent to 64.798 milligrams and the pound is 0.4535 of the standard kilogram.

AVOIRDUPOIS TABLE OF WEIGHTS

437½ grains (gr.)	1 ounce (oz.).
16 ounces	1 pound (lb.) (7,000 grains).

The apothecaries grain and the avoirdupois grain are equal in weight. The apothecaries ounce is 42½ grains larger than the avoirdupois ounce. The apothecaries pound is 1,240 grains smaller than the avoirdupois pound.

Roman Numerals

Roman numerals are used in prescriptions, the number usually following the symbol or abbreviation. For fractions, Arabic numerals are used, except in the case of one-half which is expressed by ss. The Roman numerals used in pharmacy are:

I or i=1
V or v=5
X or x=10
L or l=50
C or c=100
D or d=500
M or m=1,000

When a numeral is repeated, its value is repeated. Thus, III or iii=3; XXX or xxx=30;

CCC or ccc=300; and so on. Since V or v if doubled would be X, L or l would be C, and D or d would be M, these three numerals (V, L, and D) are never repeated. A smaller numeral placed before a larger numeral is subtracted from the latter. Only one numeral can be subtracted in this way as I from X, X from C, and C from M. Thus, IV or iv=5−1 or 4 and XC or xc=100−10 or 90, but 3 is never written IIV or iiv. A smaller numeral placed after a larger numeral is added to the larger numeral as VIII or viii=5+3 or 8; XII or xii=10+2 or 12; LV or lv=50+5 or 55; CXXIII or cxxiii=100+23 or 123.

A smaller numeral placed between larger numerals is subtracted from the larger numeral which follows it, as LIX or lix=50+9 or 59; CXL or cxl=100+40 or 140; MDCXCV or mdcxcv=1695.

A dot over the numeral I is often used as a precaution against errors. In a carelessly written prescription, it may, for example, be difficult or impossible to know whether two straight lines, slanted together at the bottom, are intended to represent II or V. If the numeral I with a dot appears elsewhere on the prescription, it is apparent that the doubtful numeral is a V. As a further precaution, in prescription writing the terminal i may be replaced by j, so that the number 2 would be represented by ij.

APPROXIMATE EQUIVALENTS

1 gram (gm.)	15.432 grains (gr.)
1 milliliter (ml.) or (cc.)	16.23 apothecaries minims (—.)
1 grain (gr.)	64.8 milligrams (mg.)
1 apothecaries ounce (℥)	31.1 grams (gm.)
1 fluidounce of water (f℥)	454.6 grains (gr.)
1 avoirdupois ounce (oz.)	28.35 grams (gm.)
1 apothecaries minim of water	0.947 grains (gr.)
1 apothecaries fluidrachm (fʒ)	3.697 milliliters (ml.)
1 apothecaries fluidounce (fʒ)	29.57 milliliters (ml.) or (cc.)
1 apothecaries gallon (Cong.)	3.785 liters (l.)
1 pint (O)	473.0 milliliters (ml.) or (cc.)
1 avoirdupois pound (℔)	453.6 grams (gm.)

APPROXIMATE MEASURES

Household measures	Apothecaries fluid measure	Metric measure
1 teaspoonful	1 fluidrachm	4.0 ml. or cc.
1 dessertspoonful	2 fluidrachms	8.0 ml. or cc.
1 tablespoonful	4 fluidrachms	16.0 ml. or cc.
1 wineglassful	2 fluidounces	60.0 ml. or cc.
1 teacupful	4 fluidounces	120.0 ml. or cc.
1 tumblerful	8 fluidounces	240.0 ml. or cc.

Pharmaceutical Arithmetic

Ratio is the relation of one number to another. It may be expressed either by whole numbers, as 15:3, or as a fraction, as $^{15}/_{3}$, and is read 15 to 3. The ratio is obtained by dividing one number by the other. Both terms of a ratio can be multiplied or divided by the same number without changing the value of the ratio. For example, if we multiply both terms of the ratio 15:3 by 5, we have 75:15. If we divide both terms by 3, we have 5:1. In each case the ratio is the same, 5:1. Taken together, the two numbers of the ratio are called a couplet. Ratio can exist only between like units, as the ratio of percent to percent or ounces to ounces, but not ounces to percent.

Proportion

A proportion is the form used to express equality between two ratios. It is written 15:3::30:6 and is read 15 is to 3 as 30 is to 6, or it is written as a fraction, $^{15}/_{3}=5$ as $^{30}/_{6}=5$. The first and last terms of the proportion are called the extremes, and the second and third terms are called the means. The product of the extremes is equal to the product of the means.

Whenever three terms of a proportion are known, the fourth can be calculated. An unknown extreme is found by multiplying the two means and dividing the product by the known extreme. An unknown mean is found by multiplying the two extremes and dividing by the known mean.

Example: If 15 gm. of a substance contains 3 gm. of an active ingredient, how many grams of active ingredient will 30 gm. of this substance contain? It is customary to use the letter "*X*" to represent the unknown term. The problem may be represented by the following equation: 15:30::3:*X*. The product of the means is 30 × 3, or 90. Dividing the product by the known extreme, we have 90÷15, or 6. The completed equation reads:

15:30::3:6

There are several methods of setting up a proportion. Some, however, do not hold true in all types of problems. To avoid difficulties it is advisable to use the following method:

Problem.—If 500 gm. of a salt solution contain 10 percent of salt, to what weight must this solu-

tion be evaporated so that the solution will be 16 percent salt?

Solution.—Set the known facts down as follows:

1. Five hundred gm. of a 10 percent solution will contain the same amount of salt as how many grams of a 16 percent solution?

or

500 gm. = 10 percent
X gm. = 16 percent

2. Let X, the unknown quantity, occupy the fourth place in the equation.

3. In the third place, put the number representing the same denomination as the unknown term. In this case, X is the total number of grams of the 16 percent solution, so the third term will be 500 gm., the given number of grams of the 10 percent solution.

4. If X is a larger number than the third term, the second term will be the larger of the two remaining known factors. If X is smaller than the third term, the second term will be the smaller of the two remaining factors.

5. The equation will be written:

$16 : 10 :: 500 : X$
$16\ X = 5{,}000$
$X = 312.5$ gm., the weight of the 16 percent solution

Changing a Fraction of One Denomination of Weights and Measures to Lower Denominations

It is often necessary or convenient to change a fraction of a higher denomination to its equivalent in lower denominations. This is most simply done by multiplying the fraction by the number of units of the lower denomination that equals one unit of the higher denomination.

Example.—To reduce four-tenths of a gallon: The next smaller unit in the apothecaries liquid measure is the pint (O).

8O (1 Cong.) × 4/10 = 32/10 O

Continue in this way changing each remaining fraction into the next lower denomination.

16 *f*℥ (1 O) × 2/10 = 3 2/10 *f*℥
8 *f*ʒ (1 *f*℥) × 2/10 = 1 6/10 *f*ʒ
60 ♏ (1 *f*ʒ) × 6/10 = 36 ♏

Therefore,

4/10 Cong. = O iii, *f*℥ iii, *f*ʒ i, ♏ xxxvi

or

4/10 gallon = 3 pints, 3 fluidounces, 1 fluidrachm, and 36 minims

Addition, Subtraction, Multiplication, and Division of Weights and Measures

Addition, subtraction, multiplication, and division in the metric system are simplified because the units increase and decrease in a tenfold ratio, but the units in the apothecaries and avoirdupois systems have no uniform scale of variation.

In the addition and subtraction of mixed units, each unit is added or subtracted separately, and the resulting sums or remainders are converted to the highest possible units.

Example.—Add 5 pounds, 2 ounces, 3 drachms, 1 scruple and 4 pounds, 2 ounces, 6 drachms, 2 scruples.

5℔	2℥	3ʒ	1℈
4℔	2℥	6ʒ	2℈
9℔	4℥	9ʒ	3℈
9℔	5℥	2ʒ	

or

Since 3 ℈ equals 1 ʒ, add the sum of the scruples to the drachms, making 10ʒ, or 1℥ and 2ʒ. The 1℥ added to the sum of the ounces makes 5℥, giving the final sum of 9℔, 5℥, and 2ʒ.

In multiplication, each unit is multiplied separately and the resulting products are converted to the highest possible denominations.

In division, it is simpler to change all the units into the lowest denomination present, divide this, and convert the quotient to the highest possible denomination.

Calculating the Dose of Each Ingredient of a Prescription

Extreme accuracy is essential in all calculations involved in the filling of prescriptions. The dose of each ingredient as written in the prescription should be carefully calculated. Routine procedure in checking doses may uncover errors which otherwise might cause serious results.

Example.—Calculate the quantity of each ingredient in a dose of the following prescription:

℞	Quinine sulfate	Drams iv
	Reduced iron	Drams ii
	Strychnine phosphate	Grains ii
	Arsenous acid	Grains iii
	Powdered ipecac	Grains xv

Make 120 pills.
Sig: One pill daily.

Procedure.—Divide the total quantity of each ingredient by the total number of doses.

Quinine sulfate	4 dr.×60=240 gr. 240÷120=2 gr. quinine sulfate.
Reduced iron	2 dr.×60=120 gr. 120÷120=1 gr. reduced iron.
Strychnine phosphate.	2 gr.÷120=1/60 gr. strychnine phosphate.
Arsenous acid	3 gr.÷120=1/40 gr. arsenous acid.
Powdered ipecac	15 gr.÷120=1/8 gr. powdered ipecac.

Specific Gravity

Specific gravity is the relative weight of equal volumes of different substances, using water as a standard. Since water is the standard, the specific gravity of water is one. Any substance lighter than water has a specific gravity less than one, and any substance heavier than water has a specific gravity greater than one. Specific gravity may be considered as the weight in grams of 1 cc. of a substance.

The formula for specific gravity may be expressed as follows:

$$\text{Specific gravity}=\frac{\text{Weight of a known volume of substance}}{\text{Weight of an equal volume of water}}$$

The pharmacist is chiefly interested in specific gravity as applied to liquids.

Specific Volume

Specific volume is the relative volume of equal weights of different substances, using water as a standard. Since water is the standard, the specific volume of water is one. Any substance lighter than water has a specific volume greater than one, and any substance heavier than water has a specific volume less than one. Specific volume may be considered as the volume in cubic centimeters of 1 gm. of a substance.

The formula for specific volume may be expressed as follows:

$$\text{Specific volume}=\frac{\text{Volume of a known weight of substances}}{\text{Volume of an equal weight of water}}$$

As with specific gravity, the pharmacist is chiefly interested in specific volume as applied to liquids.

Since specific volume is the reciprocal of specific gravity, one may easily be converted into the other:

$$\text{Specific gravity}=\frac{1}{\text{Specific volume}}$$

$$\text{Specific volume}=\frac{1}{\text{Specific gravity}}$$

Changing Weight to Volume and Volume to Weight

When calculating the weight or volume of a liquid, it is important that the pharmacist understand specific gravity. A correction must be made when the specific gravity of a liquid differs from that of water.

Finding the weight of a liquid when the volume is known:

1. When the volume is expressed in the metric system, the following rule is used:

Cubic centimeters × specific gravity = grams

This method may also be used when the volume is expressed in the apothecaries system by changing the volume into cubic centimeters. The grams may be converted into the apothecaries or avoirdupois system.

Example.—How many grams in 10 fluidounces of glycerin (sp. gr. 1.25)?

10×29.57 (cc. in 1 fl. oz.)=295.7 cc.

295.7×1.25=369.62 gm. of glycerin

2. When the volume is expressed in the apothecaries system, the volume may be multiplied by the equivalent, converting to the required system, and multiplied by the specific gravity.

Volume × equivalent × specific graviy = weight

Example.—How many apothecaries ounces in 16 fluidounces of ether (sp. gr. 0.715)?

16×0.95 (apothecaries ounces in 1 fl. oz.) = 15.20 apothecaries ounces (of water)

15.20×0.715 = 10.868 apothecaries ounces of ether

Finding the volume of a liquid when the weight is known:

1. When changing from grams to cubic centimeters, the following rule is used:

$$\frac{\text{Grams}}{\text{Specific gravity}} = \text{cubic centimeters}$$

This method may also be used when the weight is expressed in the apothecaries or avoirdupois system by changing the weight into grams. The cubic centimeters may be converted into the apothecaries system.

Example.—How many fluidounces in 500 gm. of sulfuric acid (sp. gr. 1.84)?

500÷1.84 = 271.74 cc. of sulfuric acid

271.74÷29.57 (cc. in 1 fl. oz.) = 9.18 fluidounces of sulfuric acid

2. When the weight is expressed in the avoirdupois or apothecaries system, the weight may be multiplied by the equivalent, converting to the required system, and divided by the specific gravity.

Weight × equivalent specific gravity = volume.

Example.—How many fluidounces in 100 avoirdupois ounces of chloroform (sp. gr. 1.47)?

100×0.962 (fl. oz. in 1 avoirdupois ounce) = 96.2 fluidounces (of water)

96.2÷1.47 = 65.44 fluidounces of chloroform

Finding the weight of substance in a known volume of liquid when the percentage by volume is given

When the volume of the solution is given in the metric system, the number of cubic centimeters may be multiplied by the specified percent to find the cubic centimeters of pure substance in the solution. This volume multiplied by the specific gravity of the substance will give the weight in grams of substance in solution.

Example.—How many grams of chloroform (sp. gr. 1.47) are there in 1 liter of chloroform liniment which is 30 percent by volume chloroform?

1,000×0.30 = 300 cc. of chloroform

300×1.47 = 441 gm. of chloroform in the liniment

When the volume of the solution is given in the apothecaries system, the volume may be multiplied by the specified percent to find the volume of pure substance in the solution. This volume multiplied by an equivalent changes the volume to the weight of an equal volume of water in the desired system. This weight multiplied by the specific gravity gives the weight of substance in the solution.

Example.—How many avoirdupois ounces of chloroform (sp. gr. 1.47) in 16 fluidounces of chloroform liniment which is 30 percent by volume chloroform?

16×0.30 = 4.8 fluidounces

4.8×1.04 (av. oz. in 1 fluidounce) = 4.992 av. oz. (of water)

4.992×1.47 = 7.34 av. oz. of chloroform in the solution

The volume in the apothecaries system may be converted to metric volume (cc.) and multiplied by the specified percent to find the volume of substance in the solution. This volume multiplied by the specific gravity gives the weight in grams which can be converted to the desired system.

Example.—The preceding problem.

1 pint = 473 cc.

473×0.30 = 141.9 cc. chloroform

141.9×1.47 = 208.59 grams chloroform

208.59÷28.35 (gm. in 1 av. oz.) = 7.35 av. oz. of chloroform in solution

Finding the volume of substance in a known weight of liquid when the percentage by weight is given

When the weight of the solution is given in the metric system, the number of grams is multiplied by the desired percent to find the grams of pure substance in the solution. This weight divided by the specific gravity of the substance gives the volume in cubic centimeters of substance in the solution.

Example.—How many cubic centimeters of absolute alcohol (sp. gr. 0.798) in 500 gm. of a spirit which is 70 percent absolute alcohol by weight?

$500 \times 0.70 = 350$ gm. of absolute alcohol
$350 \div 0.798 = 438.60$ cc. of absolute alcohol

When the weight of the solution is given in the apothecaries or avoirdupois system, the weight may be multiplied by the specified percent to find the weight of pure substance in the solution. This weight multiplied by an equivalent changes the weight to the volume of an equal weight of water in the desired system. This volume divided by the specific gravity gives the volume of substance in the solution.

Example.—How many fluidounces of absolute alcohol (sp. gr. 0.798) in an avoirdupois pound of a spirit which is 70 percent by weight absolute alcohol?

16 (oz. in 1 av. lb.) $\times 0.70 = 11.20$ av. oz. of absolute alcohol
11.20×0.962 (fluidounces in 1 av. oz.) $= 10.774$ fluidounces (of water)
$10.774 \div 0.798 = 13.50$ fluidounces of absolute alcohol in the spirit

The weight in the avoirdupois or apothecaries system may be converted to the metric system (gram) and multiplied by the specified percent to find the weight of substance in the solution. This weight divided by the specific gravity given the volume in cubic centimeters of substance in the solution. This volume may be converted to the desired system.

Example.—The preceding problem:

453.6 (gm. in 1 av. lb.) $\times 0.70 = 317.52$ gm.
$317.52 \div 0.798 = 397.89$ cc.
$397.89 \div 29.57$ (cc. in 1 fl. oz.) $= 13.46$ fl. oz. of absolute alcohol in the spirit

Finding the percentage by volume equal to a known percentage by weight

Example.—Find the percent by volume in a mixture of absolute alcohol (sp. gr. 0.798) and water which is 50 percent by weight absolute alcohol and has a specific gravity of 0.9181.

Base the problem on 1 gm. of the solution and understand that specific gravity is the weight in grams of 1 cc.

One gm. of the solution contains 0.50 gm. of absolute alcohol.

Therefore, $0.50 \div 0.798 = 0.626$ cc. of absolute alcohol contained in 1 gm. of the solution.

The volume of 1 gm. of the solution is $1 \div 0.9181 = 1.089$ cc.

$$\frac{0.626 \text{ (cc. of absolute alcohol in 1 gm. of solution)}}{1.089 \text{ (cc. in 1 gm. of the solution)}} = 0.574 \times 100 = 57.4 \text{ percent by volume.}$$

Finding the percentage by weight equal to a known percentage by volume

Example.—Find the percent by weight in a mixture of absolute alcohol (sp. gr. 0.798) and water which is 91 percent by volume absolute alcohol and has a specific gravity of 0.8308.

Base the problem on 1 cc. of the solution and understand that the specific gravity is the weight in grams of 1 cc.

One cc. of the solution contains 0.91 cc. of absolute alcohol.

Then, $0.91 \times 0.798 = 0.7261$ gm. of absolute alcohol contained in 1 cc. of the solution.

The weight of 1 cc. of the solution is 0.8303 gm.:

$$\frac{0.7261 \text{ (gm. of absolute alcohol in 1 cc. of solution)}}{0.8303 \text{ (gm. in 1 cc. of the solution)}} = 0.874 \text{ or } 87.4 \text{ percent by weight}$$

Percentage Solutions

There are three types of percentage solutions:

1. Weight in weight (w/w).
2. Weight in volume (w/v).
3. Volume in volume (v/v).

A weight in weight (w/w) percentage solution is a solution containing a definite weight of ingredient in 100 parts by weight of finished solution. A 25-percent (w/w) solution of a salt would contain 25 gm. of salt dissolved in 75 gm. of water, making the total finished weight 100 gm.

This solution would not have a volume of 100 cc., but it would weigh 100 gm.

A weight in volume (w/v) percentage solution is a solution containing a definite weight of ingredient in 100 parts by volume of finished solu-

tion. The percentage is always figured on the weight of water in the total volume to be made. A 25-percent (w/v) solution of a salt would contain 25 gm. of salt in enough water to make 100 cc.

A volume in volume (v/v) percentage solution is a solution containing a definite volume of ingredient in 100 parts by volume of finished solution. A 25-percent (v/v) solution of alcohol in water would contain 25 cc. of alcohol in enough water to make a total finished volume of 100 cc.

When percentage is used in prescriptions it is calculated on the following basis:

1. (w/v) for solutions of solids in liquids and solutions of gases in liquids.
2. (v/v) for solutions of liquids in liquids.

Preparing solutions of a given percentage (w/w)

1. When a definite finished weight of a solution is to be prepared—the total finished weight of the solution is multiplied by the percentage in the solution. This gives the weight of solid in the solution which subtracted from the total finished weight of the solution will give the weight of liquid required.

Example.—How many grams of mild silver protein and how many grams of water are required to make 180 gm. of a 25-percent (w/w) percentage solution?

$180 \times 0.25 = 45$ gm. of mild silver protein
$180 - 45 = 135$ gm. of water

2. When the solid is to be added to a given amount of solution—let the total finished weight of the solution equal 100 percent.

100 percent − percentage solid = percentage liquid
∴ percentage liquid : percentage solid :: weight of liquid : weight of solid

Example.—How many grams of mild silver protein are required to make a 25-percent (w/w) percentage solution using 135 cc. of water?

100 percent − 25 percent = 75 percent by weight water
$\therefore 75 : 24 :: 1.35 : X$
$75X = 3,375$
$X = 45$ gm. of mild silver protein

3. When a definite finished volume of a solution is to be prepared—it is necessary to know the specific gravity of the finished solution. The volume of the finished solution is multiplied by the specific gravity which gives the weight of the solution. This weight multiplied by the percentage solid gives the weight of solid to be dissolved in the given volume.

Example.—How many grams of a chemical are required to make a pint of a 15-percent (w/w) solution which has a specific gravity of 1.356?

$473 \times 1.356 = 641.388$ gm. of solution
$641.388 \times 0.15 = 96.21$ gm. of solid in a pint of solution

Calculating the amount of solid required to make a definite quantity of a (w/v) solution when the percentage (w/v) is given

The weight of water in the total volume of solution to be made is multiplied by the percent of the ingredient in the solution. This gives the weight of the ingredient to be dissolved in the volume of solution to be made.

Example.—How many grains of silver nitrate will be required to make a fluid ounce of a 10 percent (w/v) solution?

1 *f*℥ (of water) = 454.6 gr.
$454.6 \times 0.10 - 45.46$ gr. to be dissolved in water to make 1*f*℥ of 10 percent (w/v) solution

Calculating the amount of liquid required to make a definite quantity of a (v/v) solution when the percentage (v/v) is given

The volume of the solution multiplied by the percentage of a certain ingredient gives the volume of that ingredient in the solution.

Example.—How many cubic centimeters of alcohol in a pint of spirit which contains 63 percent alcohol?

$473 \times 0.63 = 297.99$ cc. of alcohol

Calculating the amount of solid required to make a given volume of a parts-per-thousand solution

The term "parts per thousand" is used to express parts of solids per thousand parts of solution. It is a convenient way to express the strength of very dilute solutions and is written $1/_{1,000}$ or 1 : 1,000.

Example.—How many grains of cocaine are required to make 4 fluid ounces of a 1:1000 solution?

$$454.6 \times 4 = 1{,}818.4 \text{ gr. in 4 fluidounces}$$
$$1{,}000 : 1{,}818.4 :: 1 : X$$
$$1{,}000\,X = 1{,}818.4$$
$$X = 1.8184 \text{ gr. of cocaine}$$

Making a certain percentage solution when the amount of solid is given

Each 100 cc. of solution (for (w/v) solutions) or 100 gm. (for (w/w) solutions) will contain a number of grams equal to the percentage of solid. The percentage strength of the solution will be the number of grams of solid in the solution divided by the number of grams in 100 cc. (or 100 gm.) multiplied by 100.

Example.—How many cubic centimeters of physiological salt solution (0.85 percent) can be made from one-fourth avoirdupois pound of salt?

Each 100 cc. of physiological salt solution contains 0.85 gm. of salt.

$$\tfrac{1}{4} \text{ avoirdupois pound} = 113.4 \text{ gm.}$$
$$\frac{113.4}{0.85} \times 100 = 13{,}341 \text{ cc.}$$

Finding the percentage strength of a solution when the weights of solid and liquid are known

The weight of the solid plus the weight of the liquid equals the total weight of the solution. Let the total weight equal 100 percent. The percentage strength of the solution will be the weight of solid in 100 gm.

Example.—If 1 fluidounce of water is used to dissolve 5 gm. of potassium iodide, what is the percentage strength of the solution?

$$1 \text{ fluidounce of water} = 29.57 \text{ gm.}$$
$$29.57 + 5 = 34.57 \text{ gm.}$$
$$34.57 : 5 :: 100 : X$$
$$X = 14.46 \text{ percent}$$

Calculating the (w/w) percentage of saturated solutions when the solubilities are known

The solubility of a substance is expressed as the number of cubic centimeters required to dissolve 1 gm. of substance at a specified temperature.

Example.—Potassium iodide has a solubility of 1 gm. in 0.7 cc. of water. What is the percentage strength (w/w) of a saturated solution of potassium iodide in water?

$$1 + 0.7 = 1.7 \text{ gm.}$$
$$(1 \div 1.7) \times 100 = 58.8 \text{ percentage strength (w/w)}$$

Calculating the quantity of solid required to make a definite volume of a saturated solution when the solubility is known

This method may be used when the substance is relatively inexpensive and not very soluble.

Calculate the percentage strength (w/w) of the saturated solution. Calculate how much of the substance must be added to a volume of liquid equal to the volume of solution to be made. This will make a slightly larger volume of finished solution than is needed.

Example.—One gm. of morphine sulfate is soluble in 16 cc. of water. How many grains of morphine sulfate are required to make 4 fluid ounces of a saturated solution?

$$1 + 16 = 17$$
$$\frac{1}{17} \times 100 = 5.88\% \text{ (w/w) solid in a saturated solution of morphine sulfate}$$
$$100\% - 5.88\% = 94.12\% \text{ (w/w) liquid in a saturated solution of morphine sulfate}$$
$$454.6 \times 4 = 1{,}818.4 \text{ grains in 4 fluidounces of water}$$
$$94.12 : 5.88 :: 1{,}818.4 : X$$
$$94.12X = 9{,}257.792$$
$$X = 113.60 \text{ grains required to make 4 fluidounces of saturated solution}$$

Stock Solutions

Stock solutions which are concentrated may be diluted to make weaker solutions. They may be of any desired strength. It is faster and more convenient to measure out a solution than it is to weigh a solid and dissolve it each time a quantity is needed. When a fraction of a grain is needed, it is best to have a stock solution of such a strength that 1 grain is contained in 12 minims. Many stock solutions are made of such a strength that 1 part is contained in 10 (or some multiple of 10) parts.

Example.—How many minims of a stock solution containing 1 gm. of potassium permanganate in 100 cc. are required to make a pint of a 1:3,000 (w/v) solution?

The first step is to calculate how much of the solid is required to prepare the solution called for.

$$3{,}000 : 473 : : 1 : X$$
$$3{,}000\ X = 473$$

$X = 0.157$ gm. of potassium permanganate required

The second step is to calculate the amount of the strong solution required to obtain the amount of solid needed.

$$1 : 0.157 : : 100 : X$$

$X = 15.7$ cc. of stock solution required

Stock Powders

Stock powders are powders containing a definite amount of active ingredient diluted with milk sugar. They are used in dispensing in the same way as stock solutions, the powder being more convenient for some preparations. For use in metric prescriptions, a dilution of 1 in 10 (or a multiple of 10) is most convenient, but for apothecaries prescriptions, a concentration of 1 in 12 (or a multiple of 12) is most convenient.

Example.—How many grams of a 1 in 10 stock powder of morphine sulfate are needed to prepare a pint of a 1 : 500 solution of morphine sulfate?

$$500 : 473 : : 1 : X$$
$$500\ X = 473$$

$X = 0.946$ gm. of morphine sulfate required

$0.946 \times 10 = 9.46$ gm. of the stock powder required

Alligation

Alligation, called the rules of mixtures, is a method used in pharmacy to determine the strengths of mixtures of different percentage strength substances or the cost of mixtures of different priced substances.

It is divided into two methods, alligation medial and alligation alternate.

Alligation Medial

This is used to determine the percentage strength of a mixture of two or more different strength ingredients or the cost of a mixture of two or more different priced ingredients; it also can be used to determine the specific gravity of a mixture of two different liquids with different specific gravities.

Example.—What would be the percentage strength of a mixture of 20 grains of a 12 percent opium with 30 grains of a 9 percent opium?

20 gr. $\times 12$ percent $= 2.4$ gr. of pure opium

$\dfrac{30 \text{ gr.}}{50 \text{ gr.}} \times 9 \text{ percent} = \dfrac{2.7 \text{ gr.}}{5.1 \text{ gr.}}$ of pure opium

50 gr. of mixture containing 5.1 gr. of pure opium

Then determine what percent the 5.1 grains of pure opium are of the total mixture, or

$5.1 \div 50 \times 100 = 10.2$ percent of the mixture is pure opium

Example.—What would be the cost per ounce of a mixture containing 6 ounces of a substance that cost \$0.20 per ounce and 10 ounces of a substance that cost \$0.30 per ounce?

6 ounces $\times$ \$0.20 = \$1.20, the cost of the 6 ounces
10 ounces $\times$ \$0.30 = \$3.00, the cost of the 10 ounces
16 ounces of the total mixture cost \$4.20

If 16 ounces cost \$4.20, what would be the cost of 1 ounce?

\$4.20 $\div$ 16 = \$0.26¼, the cost per ounce

Example.—What would be the specific gravity of a mixture of 500 cc. of a liquid that has a specific gravity of 2.5 and 400 cc. of a liquid that has a specific gravity of 1.375?

500 cc. $\times 2.5 = 1{,}250$ gm. of liquid

$\dfrac{400 \text{ cc.}}{900 \text{ cc.}} \times 1.375 = \dfrac{550 \text{ gm.}}{1{,}800 \text{ gm.}}$ of liquid

900 cc., total volume, has a weight of 1,800 gm.

Then,

$\dfrac{900 \text{ gm., the weight of 900 cc. of water}}{1{,}800 \text{ gm., the weight of 900 cc. of liquid}} = 2.000,$

the specific gravity

Alligation Alternate

Alligation alternate is the method of calculating the proportional quantities of two or more substances of different strength required when mixed to produce a mixture of a desired strength. At least one substance must be stronger and one weaker than the produced intermediate strength.

There are several ways of setting down the alligation form, all of which are the same in principle.

Example.—In what proportion must 5 percent and 18 percent alcohol be mixed to make an 8 percent alcohol solution?

5	8	10 parts of 5 percent alcohol
18		3 parts of 18 percent alcohol
		13 parts of 18 percent alcohol

$18-8=10$ parts of 5 percent alcohol
$8-5=3$ parts of 18 percent alcohol

The term "parts" may be any unit.

Any number of different strengths may be mixed, applying the same principles. Arrange the problem as in the first example, connecting each of the terms which is less than the required term with one which is greater. Each set of terms is worked as a separate problem.

Example.—In what proportion must 15, 21, 46, and 60 percent alcohol be mixed to make 45 percent alcohol?

15	45	15 parts of 15 percent
21		1 part of 21 percent
46		24 parts of 46 percent
60		30 parts of 60 percent
		70 parts of 45 percent

or

15	45	1 part of 15 percent
21		15 parts of 21 percent
46		30 parts of 46 percent
60		24 parts of 60 percent
		70 parts of 45 percent

When an odd number of different strengths is to be mixed, or when the number of percentages lower than the desired percentage is not equal to the number of percentages higher than the desired percentage, some of the terms must be used more than once.

Example.—In what proportion must 5, 26, and 30 percent alcohol be mixed to make 28 percent alcohol?

5	28		2		2 parts of 5 percent
26		2			2 parts of 26 percent
30		2		23	25 parts of 30 percent
					29 parts of 28 percent

In the examples cited, the parts of the various substances are proportional parts and any multiple of them may be used.

Finding the amounts necessary to make a given quantity of a definite percentage strength

Example.—How many cubic centimeters of 20 percent and 38 percent alcohol must be mixed to make a pint of 25 percent alcohol?

20	25	13 parts of 20 percent
38		5 parts of 38 percent
		18 parts of 25 percent

$18=$total number of parts to be made
$473=$total number of cubic centimeters to be made

$$18 : 473 :: 13 : X$$
$X=341.6$ cc. of 20 percent alcohol
$$18 : 473 :: 5 : X$$
$X=131.3$ cc. of 38 percent alcohol

Finding the amount of one ingredient necessary to mix with a known amount of another to make a definite percentage strength

Example.—How many cubic centimeters of 33 percent alcohol must be mixed with 2 fluidounces of 48 percent alcohol to make a 39 percent alcohol?

33	39	9 parts of 33 percent
48		6 parts of 48 percent

$29.57\times2=59.14$ cc. in 2 fluidounces
$$6 : 59.14 :: 9 : X$$
$$6\ X=532.26$$
$X=88.71$ cc. of 33 percent alcohol required

Finding the amount of a certain percentage strength substance necessary to be added to a mixture of two or more known percentages to make a definite percentage

Example.—How many cubic centimeters of a 60 percent sulfuric acid by volume must be added to 330 cc. of 30 percent sulfuric acid and 165 cc. of 15 percent sulfuric acid to make 50 percent sulfuric acid?

$330\times30=\ 9{,}900$
$165\times15=\ 2{,}475$

$495 \qquad 12{,}375$
$12{,}375\div495=25$

There are 495 cc. of 25 percent sulfuric acid in the mixture before adding the 60 percent sulfuric acid.

Then, how many cubic centimeters of 60 percent sulfuric acid must be added to the mixture to make 50 percent sulfuric acid?

60	50	25 parts of 60 percent sulfuric acid
25		10 parts of 25 percent sulfuric acid

$$10 : 25 :: 395 : X$$
$$10X=12{,}375$$
$X=1{,}237.5$ cc. of 60 percent sulfuric acid required

HEAT

Sources of Heat

Heat is a form of energy caused by chemical action, electricity, friction, or light.

Combustion is a chemical oxidation accompanied by heat and light. Any substance, solid, liquid, or gas which is combustible is called a fuel.

Solid fuels are wood, coal, coke, and charcoal. In these fuels the chemical action is the uniting of carbon with oxygen of the air. In order to produce complete combustion a good source of oxygen is necessary.

Liquid fuels are alcohol and petroleum products. These fuels vary considerably in volatility, and the method used for their combustion depends on this factor.

Gaseous fuels used in pharmacy to produce heat are natural gas and coal or artificial gas. These gases are combinations of carbon which furnish the heat and light during combustion.

Heat Distribution and Regulation

A wire gauze is used over a flame to distribute heat uniformly. The wire is a good conductor and the heat penetrates readily.

A sand bath is a vessel in which dry, fine sand can be heated. It must be made of a material that will withstand high temperatures. The container of liquid to be heated is placed on a thin layer of sand in the dish, and sand is placed around it. Heat is applied to the bottom of the dish and is transmitted uniformly to all parts of the container.

A liquid bath is a metal vessel of convenient size, usually made of tinned-copper. The most common type is a circular bowl in which the liquid is heated, with a lid composed of concentric rings which can be removed in order to permit the largest possible surface of the vessel being heated to be exposed to the heat. The liquids usually used are water or oil. When relatively high temperatures are desired, oils are used. Since water boils at 100° C. the water bath is used for heating or evaporating liquids when a temperature not exceeding 100° is desired.

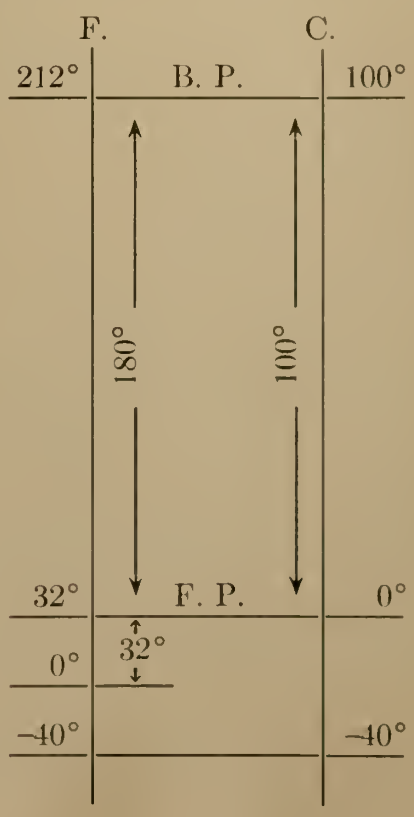
A steam bath differs from a water bath only in that the substance to be heated comes in contact with steam rather than water.

Measurement of Heat Intensities

Thermometers are instruments for measuring the intensities of heat. Most of these instruments are based on the expansion of certain liquids. The usual form consists of a glass bulb to which is attached a capillary tube, accompanied by a scale of degrees. The bulb and lower part of the tube are filled with boiled mercury. As the mercury is heated, it expands up into the tube. The temperature is recorded on the accompanying scale. Thermometers are constructed with various scales for individual purposes. Those used in pharmacy are the centigrade and Fahrenheit scales.

The conversion from one scale to the other can be accomplished by studying the accompanying illustration and applying the following rules.

The boiling point of water is 212° F. and 100° C. The freezing point of water is 32° F. and 0° C. The difference between the boiling point and the freezing point of water is 180° F. and 100° C. Thus the equivalent is $^{100}/_{180}$ or $^{5}/_{9}$ when converting from Fahrenheit to centigrade, and $^{180}/_{100}$ or $^{9}/_{5}$ or 1.8 when converting from centigrade to Fahrenheit.



Zero of the Fahrenheit scale is 32° below zero of the centigrade scale. It is therefore necessary to subtract 32 from the Fahrenheit reading before multiplying by the equivalent to change from Fahrenheit to centigrade. For the same reason, 32 must be added to the centigrade reading after multiplying by the equivalent when converting from centigrade to Fahrenheit.

To change from Fahrenheit to centigrade:

$$\text{Fahrenheit reading } -32\times 5/9$$

or

$$\text{Fahrenheit reading } -32\div 1.8$$

To change from centigrade to Fahrenheit:

$$\text{Centigrade reading } \times 9/5+32$$

or

$$\text{Centigrade reading } \times 1.8+32$$

or

$$\text{Centigrade reading } \div 5/9+32$$

Application of Heat

The application of heat can be considered under two classes: (a) Those operations in which comparatively high temperatures are required, as calcination, ignition, deflagration, carbonization, exsiccation, and incineration; and (b) those which require moderate or low temperatures, as torrefaction, fusion, vaporization, evaporation, desiccation, distillation, and sublimation.

The application of heat may also be divided into the two classes: (*a*) Chemical change, as calcination, ignition, deflagration, carbonization, incineration, torrefaction; and (*b*) physical change as fusion, vaporization, evaporation, desiccation, exsiccation, distillation, and sublimation.

Calcination is the process of strongly heating a carbonate, driving off CO_2 leaving the oxide.

Example.—Preparation of CaO from $CaCO_3$ + heat $\rightarrow CaO + CO_2$.

Ignition is the process of strongly heating inorganic matter, leaving the nonvolatile residue.

Example.—The chemical determination of ash in a substance.

Deflagration is the process of strongly heating a substance readily yielding oxygen, producing a crackling sound.

Example.—This process is not used in pharmacy, but some official chemicals are tested in this way; for example potassium nitrate.

Carbonization is the process of strongly heating an organic substance without access of air, leaving carbon.

Example.—The preparation of charcoal.

Incineration is the process of strongly heating an organic substance with access of air, leaving only ash.

Example.—Any open fire burning organic matter.

Torrefaction is the process of moderately heating organic matter with access of air, not destroying the active principles of the substance. This is commonly called roasting.

Example.—Roasting coffee.

Fusion is the process of converting a solid into a liquid by means of heat.

Example.—The melting of cocoa butter in preparation of suppositories.

Vaporization is the process of converting a liquid or a solid into vapor.

Example.—The removal of alcohol from water by the application of a gentle heat.

Desiccation is the process of removing water from a substance at moderate temperature.

Example.—The drying of any substance by exposure to air or by placing a substance in an airtight container with a drying agent.

Exsiccation is the process of removing the water of crystallization from a chemical by use of strong heat.

Example.—The determination of water of crystallization in a chemical by heating, driving off the water, and leaving the exsiccated salt.

Distillation is the process of converting a liquid to a vapor and condensing the vapor back into a liquid.

Example.—Preparation of distilled water.

Sublimation is the process of distilling a solid.

Example.—Purification of sulfur.

Melting Point.—The melting point is the temperature at which a substance melts or fuses. Since the melting point of a substance is lowered by the presence of impurities, it is used as a means of determining purity.

The melting point determination is made by placing a small amount of the powdered substance in a capillary tube, which is fastened to a thermometer, and slowly heating the tube and thermometer in a liquid bath until the solid in the capillary tube

begins to liquefy. The U. S. P. gives specific directions for this determination.

Boiling Point.—The boiling point of a substance is the temperature at which its vapor pressure is equal to one atmosphere of pressure at sea level. Water boils at 100° C. when the pressure of one atmosphere (76 cm. of mercury) is exerted on its surface. The fact that each substance has a definite boiling point is useful in identifying and purifying liquids. A method for determining this physical property is described in the U. S. P.

COMMINUTION

Comminution is the process of reducing a substance to finer particles. The chief object of comminution is to prepare the drug in a form in which it is more susceptible to solution.

The degrees of fineness are represented by the terms cutting, grating, bruising, grinding, pulverizing, trituration, levigation, and elutriation.

Cutting or slicing can be performed by any sharp edge, as a knife. This operation is rarely used in pharmacy except for preparing drugs for more complete processes of comminution.

Grating as applied in pharmacy is limited to the comminution of nutmeg or lemon peel.

Bruising or contusion can be performed in a heavy mortar, but the process has been replaced by grinding in a mill.

Pulverizing is grinding to a fine powder and is accomplished in the same way as grinding.

Trituration is the process of reducing a substance to a fine powder and is usually accomplished by placing the substance in a mortar and applying the pestle with a rotary motion.

Levigation is the process of reducing a powder to a still finer powder. It is accomplished by placing the substance on a glass slab, moistening it, and smearing it over the slab by means of a muller.

Elutriation (water-sifting) is the process of separating coarse from fine particles by suspension in water. It is used only in separating insoluble substances.

Pulverization by intervention is the method of reducing a substance to a powder by dissolving it in a small amount of solvent and triturating until dry. Camphor is best powdered by this method.

SOLUTION

A solution is a homogeneous mixture of two or more substances. This is not to be confused with the class of official preparations known as solutions. From a physical-chemical standpoint they may be classified as (a) molecular, as dissolving phenol in water; (b) ionic, as dissolving potassium iodide in water; and (c) colloidal, as dissolving gelatin in water.

A **solvent** is the liquid in which the substance being dissolved loses its identity, or goes into solution.

A **solute** is the substance being dissolved.

Solubility is the amount of solute which dissolves in a given solvent. There is no general rule for solubility; however, most salts are soluble in water. Most of the common organic substances are soluble in organic solvents, as alcohol, chloroform, ether, and acetone. Solubility or solution can be facilitated by powdering a substance before mixing with the solvent, agitating the mixture, and raising the temperature of the solution.

The solubility of the official substances in the common solvents are given in the Pharmacopoeia and National Formulary, and the solubility of other substances may be obtained from various chemical handbooks.

A **circulatory solution** is used to aid the solution of certain substances which dissolve rather slowly. In this process the substance is tied in a piece of cloth and suspended just below the surface of the solvent. The liquid coming in contact with the substance dissolves the substance, thus increasing in density and sinking to the bottom, and a fresh supply of solvent comes in contact with the substance. In this way, a circulation is set up in the container.

A **supersaturated solution** is a condition of solution in which the solvent actually dissolves and holds more solute in solution than it will under normal conditions. Hot water usually dissolves more substance than cold water, and on cooling the excess substance will usually come out of solution. In some cases, the excess dissolved substance will remain in solution until the solution is distributed by agitation.

When a substance is dispersed throughout another, the properties of the mixture depend

somewhat on the size of the dispersed particles. When the particles are in the ionic or molecular state, the mixture is homogeneous, and the requirement of our definition for a solution is fulfilled. We call this a true solution. A colloidal solution will not meet these requirements. A colloidal solution consists of two phases, a liquid phase which is usually referred to as the dispersion medium or the external phase, and a solid phase or another liquid phase dispersed in the external phase, called the dispersed phase or internal phase. In general we may classify a solution as colloidal when the diameter of the dispersed particles is between 0.1 micron (0.0001 mm.) and 1 millimicron (0.000001 mm.).

There are two types of colloid solutions, suspensoids and emulsoids. In the suspensoid dispersion, there is no marked affinity between the internal and external phase. An example is a dispersion of metallic gold in water. In an emulsoid dispersion, there is a marked affinity between the two phases, and the dispersed phase exists as a liquid. An example is gelatin dispersed in water.

Separation of Solids From Liquids

The method to be used in separating solids from liquids depends on several factors: (a) Size and amount of the particles to be separated, (b) total amount of the mixture to be separated, (c) whether it is the solid or the liquid which is to be discarded, and (d) whether or not the separation is to be quantitative.

Decantation is the process of separating a solid from a liquid by allowing the solid to settle and pouring off the liquid. It is employed in washing precipitates by adding the wash solution, allowing the solid to settle, and pouring off, continuing the process until free from impurities. If the solid to be separated settles rather rapidly, decantation may be employed to advantage.

Colation is the process of straining. It is a rapid method of separation and is used where the particles to be separated are coarse and a quantitative separation is not necessary.

Filtration is the process of separating a solid from a liquid by passing the liquid through a medium. The liquid which passes through is called the filtrate, and the solid remaining on the filtering medium is called the residue. The filtering medium may consist of cotton, paper, asbestos, felt, or other material. The degree of quantitative separation will depend on the medium used. One of the most rapid methods is filtering through cotton. This can often be used in prescription work, as it saves time and gives a satisfactory result. For separating fine solids which will pass through cotton, filter paper is used, which will usually give nearly perfect separation. Several rapid processes of filtering are used both in the laboratory and in large-scale manufacturing.

Precipitation is the formation of solid particles from a solution by physical or chemical action. The solid which separates is called the precipitate, the cause of the precipitation is called the precipitant, and the liquid from which the precipitate is precipitated is called the supernatent liquid. Reasons for precipitating a substance are: (*a*) to effect purification of solids, (*b*) to obtain a solid as a fine powder, (*c*) to indicate a reaction in qualitative testing, and (*d*) to reduce the bulk of solutions. Most precipitates are formed as the result of a chemical reaction, but physical action may cause precipitation, as is shown when a supersaturated warm solution is cooled or when a substance in solution is precipitated by adding a solution in which the solid is insoluble; for example, the addition of water to an alcoholic solution of resinous drugs.

Crystallization is the process of separating solids into forms having definite geometric angles. These substances are said to be crystalline. Substances which solidify into no definite shape are said to be amorphous. A crystallizing substance always crystallizes into its own particular shape, the angles always being the same. The color and shape of the crystal are often used as a method of distinguishing chemicals.

Crystals may be forced by various methods:

1. Cooling a hot saturated solution.
2. Evaporating a solution of the substance.
3. Changing the solvent to one in which the substance is insoluble.
4. Sublimation.

Many substances in the process of crystallization combine with water, and this water is termed water of crystallization. This water combination must be distinguished from the mechanical retention known as interstitial water, which is the water enclosed in a purely mechanical manner when crystals are formed. Some substances do not al-

ways crystallize with the same amount of water of crystallization.

Efflorescence occurs when crystals lose their water of crystallization at ordinary temperatures. An example is a crystal of ferrous sulfate, a pale green crystal when formed. If left exposed to the air, it loses its water of crystallization, and the dry ferrous sulfate forms on the outside of the crystal as a nearly white powder.

Hygroscopic substances are those which absorb moisture from the air and become damp, but without liquefying. An example is argyrol.

Deliquescence occurs when some solids absorb enough moisture from the atmosphere to liquefy. An example is sodium hydroxide.

In the **separation of immiscible** liquids when the amount of liquid is small, a pipette or syringe may be used to draw off one liquid from the other. If the amount of liquid is large, it may be separated with a syphon. These methods are rather crude and should be used only when a better method is impractical. The separatory funnel is satisfactory for separating liquids and is used in alkaloid assaying and other near quantitative separations.

EXTRACTION

Extraction includes the processes of expression, maceration, and percolation. Its primary purpose is to separate the active principle from the inert part in order to obtain a more concentrated form of the drug. The methods of extraction differ widely, but the purpose of each is essentially the same, that is, to dissolve the active principles and separate them from the residue, which is called the marc.

A knowledge of the active ingredients to be extracted is essential in order to select the correct menstruum to be used for extraction.

Water is the most commonly used solvent. Cold water is a good solvent for many plant constituents, as alkaloids, glucosides, sugars, mucilaginous substances, and salts. Hot water may cause plant tissues to swell and disintegrate and the active principles to be extracted more rapidly. The greatest disadvantage in the use of hot water is that it will often extract substances which will separate on cooling.

Alcohol will not extract as wide a range of substances as water, but for certain extractions it is very useful. It is a good solvent for alkaloids, glucosides, oils, and resins. It is also a good preservative in the finished product.

Hydro-alcoholic menstruum has been found to extract almost as well as alcohol and to have few if any of the disadvantages of water. Experiments have shown that an alcohol concentration as low as 30 percent is satisfactory for some preparations.

Glycerin is a good solvent for tannins, gums, and albumins, and it is sometimes added to the menstruum to aid in the extraction of tannin-containing drugs.

Ether, purified benzin, acetone, and chloroform are all highly selective solvents, but they are not suitable for liquid preparations intended for internal use because of their volatility, odor, and taste. They are used commercially, however, in the extraction processes of several official preparations when the solvent is evaporated from the finished product.

Expression is the process of removing the liquid from a moist mass by pressure. It is used to remove the last part of menstruum in most processes of extraction. Many forms of equipment are used, depending on the nature of the substance and the quantity to be expressed.

Maceration is the process of removing the active principle from drugs by allowing the drug to soak in the menstruum, with frequent agitation. The menstruum is removed from the residue or marc by filtering or straining. Maceration is used when percolation is not satisfactory because the drug is gummy or resinous and would clog the percolator. Maceration has an advantage over percolation from the standpoint of economy, as less alcohol is lost in the process, but this advantage is probably outweighed by the fact that the active principles are not as completely extracted.

Percolation is the process of extracting the soluble constituents of a drug by passing a solvent called the menstruum through the powdered drug, which is packed in a suitable container called a percolator. The solution which has passed through the percolator and extracted the active principles of the drug is called the percolate.

The degree of fineness to which the drug is subdivided for percolation depends on the nature of the drug, the solvent used, and the completeness of extraction desired. The detailed information for percolating official preparations is given in the

U. S. P. and the N. F. It includes instructions for dampening the drug, packing the percolator, macerating before percolating, the menstruum to be used, and the rate of percolation.

PHARMACEUTICAL PREPARATIONS

Waters

Waters include a group of flavored and medicinal solutions known as aromatic waters, as well as water in four stages of purity.

Aromatic waters are saturated aqueous solutions of volatile substances. The volatile substance may be solid, liquid, or gaseous.

Waters are prepared by solution or by distillation. The method of solution is to shake the volatile substance with distilled water and repeat the agitation several times during a period of 15 minutes, let stand 12 hours, filter through a wetted filter, and make up to volume.

Waters may also be prepared by an alternate solution method, which is to triturate the volatile substance with 14 gm. of talc or other insoluble adsorbent material, add distilled water, thoroughly agitate several times during 10 minutes, filter the mixture, and make up to volume.

Only three of the official aromatic waters are prepared by distillation, Stronger Rose Water U. S. P., Orange Flower Water U. S. P., and Hamamelis Water N. F. Most of the official waters can be made by the distillation process, but the solution method is used when possible as it is much faster and more convenient, and produces a water which is satisfactory.

Spirits

Spirits are alcoholic solutions of volatile substances. Spirits differ from waters in the solvent used and the amount of volatile substance dissolved. The official spirits range from 5 to 20 percent volatile substance and from 54 to 95 percent alcohol. They are prepared by simple solution or dilution, solution by maceration, distillation, and chemical action. Most of the spirits are prepared by simple solution, which is simply adding the volatile substance to the alcohol. A general formula, for use when the amount of volatile substance is not given, is found in the National Formulary. This formula directs the use of 6 percent volatile substance in the solvent.

Spirit of peppermint and spirit of spearmint are made by maceration. The mint leaves are first macerated in water and expressed. The moist leaves are added to alcohol and allowed to stand with frequent agitation. The solution is filtered, oil added to the filtrate and made to volume with alcohol.

Whisky and brandy are examples of spirits made by distillation, and spirit of nitrous ether and spirit of glyceryl trinitrate are made by chemical action.

Elixirs

Elixirs are pleasantly flavored, sweetened, hydro-alcoholic solutions, usually containing medicinal substances. Most elixirs are prepared by adding medicinal substances to Aromatic Elixir U. S. P. or some other elixir. When the ingredients for an elixir are mixed, a cloudy liquid often results. It will usually filter clear after standing for a few hours, or by adding purified talc and agitating. Elixirs should be clear when dispensed. They keep well and may improve with age if not subjected to direct sunlight or extreme temperatures.

Fluidextracts

Fluidextracts are alcoholic liquid preparations of vegetable drugs made by percolation, representing in each cubic centimeter the activity of 1 gm. of the drug. They are similar in many respects. All have a strength of 100 percent, their methods of manufacture are similar, their medicinal properties are those of the drugs from which they are derived, and their dose is the same as that of the drug itself.

Their preparation by the usual processes calls for the concentration of the more dilute portion of the percolate by distillation, which is carried out commercially in a vacuum still at a temperature below 60° C. The period of maceration of the drug prior to percolation varies for different drugs, depending on their ease of extraction. The term "percolate slowly" indicates a rate of 1 cc. or less per minute, "moderate" is 1 to 3 cc. per minute, and "rapid" is 3 to 5 cc. per minute.

The drug must be finely subdivided or powdered so that as much of the cell contents as possible can come in contact with the solvent in order to obtain the best results in percolation. The particles

should be uniform in size, allowing the menstruum to flow uniformly. The quantity of menstruum required to dampen the drug to the proper degree before packing in the percolator depends on several factors, the nature of the drug and the menstruum used being most important. The official directions specify 600 to 800 cc. of menstruum to 1,000 gm. of the drug.

There are five official processes of preparation, A, B, C, D, and E. Process A is used for fluidextracts which use alcohol or alcohol and water as the menstruum by ordinary percolation. Process B is used when portions of the menstruum contain, in addition to alcohol or alcohol and water, other solutions such as acid or glycerin. Process C is used for drugs which are injured by heat, or as an alternate process for A or B, or in cases where the percolate cannot be concentrated by distilling. Process D is used for preparing fluidextracts with boiling water as the menstruum, alcohol being added to the concentrated percolate. Process E is a modification of C and can be used as an alternate for A, B, or C. The percolation is conducted under pressure on a column of the drug much greater in height than in diameter.

Tinctures

Tinctures are alcoholic or hydro-alcoholic solutions of drugs made by extraction. They may be prepared by maceration, percolation, or simple solution. The tinctures of the potent drugs represent 10 gm. of the drug in each 100 cc. of the tincture, as compared with the fluidextracts which represent 100 gm. of the drug in each 100 cc. of fluidextract. Some tinctures are 20 percent solutions, but orange and lemon peel tinctures are each 50 percent solutions.

In the USP and NF maceration is designated as Process M and percolation as Process P. Tinctures are prepared by maceration only when percolation is not practical, as in the case of extracting resinous drugs with alcohol which form a sticky mass in the percolator, interrupting percolation.

In general, drugs requiring strong alcohol for extraction are those containing resins, gum, oleoresins, or volatile oil; those extracted with glycerin in the menstruum are tannin-bearing drugs; those having acetic acid in the menstruum are drugs containing volatile alkaloids; while the ordinary drugs containing glucosides, neutral principles, or stable alkaloids are extracted with diluted alcohol in various strengths.

The practice of diluting fluidextracts to prepare tinctures is not recommended, but when necessary tinctures can be prepared in this manner.

Liquors

Liquors are aqueous preparations made by simple solution or chemical solution. They are used internally or externally, and some are used in manufacturing other preparations. The liquors can be divided into four classes based on the following ways by which the solution may be prepared:

1. Simple solution.
2. Chemical reaction.
3. Simple solution with sterilization.
4. Extraction.

Syrups

Syrups are concentrated aqueous solutions of sucrose containing medicinal or flavoring substances. A concentrated aqueous solution of sucrose is called simple syrup. If the substance added to this is a flavor, the syrup is called a flavored syrup. If the substance added is a medicinal substance, the syrup is called a medicated syrup.

There are two processes of dissolving the sugar in the solution. The first is to heat the mixture until the sugar is in solution. The second is the cold process which may be accomplished by agitating the sugar in the solution until dissolved or by percolating the sugar with the solvent.

EMOLLIENTS

Ointments

Ointments, pastes, salves, cerates, and plasters are known as emollients. They are all used to apply medication to the skin and differ chiefly in their consistency, melting points, and adhesiveness. Ointments are semisolid preparations containing medicinal substances in a fatty or oily base, of sufficient softness to permit their being applied to the skin by inunction, and gradually liquefying when in contact with the skin.

They are used as protectives, agents for softening the skin, and a means of applying drugs locally.

At one time it was thought that the choice of an ointment base was important because it was absorbed by the skin, but the most recent evidence indicates that ointment bases tend to delay absorption through the skin and mucous membrane. It is not the penetration of the base which determines whether absorption will occur through the skin, but the solubility between the drug and the base. Recently substances possessing strong hydrophyllic properties have been used.

Substances to be incorporated in ointment bases should always be in finely divided form or dissolved before incorporating if possible. There are three methods of preparation: slab and spatula, mortar and pestle, and the ointment mill.

The proportion of petrolatum, white petrolatum, yellow wax, or white wax to be used in making official ointments may be varied to maintain a suitable consistency under different climatic conditions, providing the percentage of active ingredients is not changed.

Pastes

Pastes are ointment-like mixtures of starch, dextrin, zinc oxide, sulfur, etc., made into a paste with glycerin, soft soap, petrolatum, lard, and other fats. The term paste is also applied to preparations of jellies containing glycerin with starch, glycerogelatins, or other water soluble gels, as pectin and tragacanth. These are dermatologic preparations prepared like ointments, containing as much as 50 to 70 percent powders in the various vehicles. The water soluble gels are useful when the fatty bases are undesirable. They have the advantage of being easily removed.

Cerates

Cerates are fatty preparations of medicinal substances to be used by spreading on a cloth and applying locally. They resemble ointments but have a higher melting point because of their wax content.

Plasters

Plasters are solid or semisolid preparations, with or without medicinal substances, which are spread on cloth, intended to be applied to the skin, and sufficiently adhesive to adhere firmly. Plasters differ from the other emollients in being free from fats and more adhesive. The bases used for plasters are gum resins, Burgundy pitch, and rubber.

SUPPOSITORIES

Suppositories are solid bodies of various weights and shapes, adapted for introduction into different orifices of the human body, except the mouth, and usually dissolving, melting, or softening at body temperature. The bases generally employed are the theobroma oil or glycerinated gelatin. Adult rectal suppositories usually weigh 2 gm., vaginal suppositories 5 gm., and urethral suppositories are either 7 cm. long, weighing 2 gm., or 4 cm. long, weighing 4 gm. There are three methods of making suppositories:

1. By hand. Reduce the medicinal substance, if dry, to a very fine powder, or if an extract, soften it with a liquid. Mix thoroughly in a mortar with about an equal weight of cocoa butter. Incorporate the remainder of the cocoa butter until a homogeneous mass is obtained. Roll the mass on a graduated tile until a cylinder of the proper length is formed. Divide into the required number and form each into the desired shape, pointed at one end.

2. Cold compression method. Mix the medicinal substance in a mortar with an equal weight of grated cocoa butter. Incorporate thoroughly with the remainder of the cocoa butter previously grated. Transfer the mass to the cylinder of the suppository compressor, and compress the desired number of suppositories.

3. Fusion method. Mix the medicinal substance with the cocoa butter or other base in an evaporating dish. Gently heat on the water bath and allow to cool until nearly congealed. Pour into suitable molds which have previously been cooled. The molds should be lubricated with soap liniment if a base of cocoa butter is used, or with mineral oil if glycerinated gelatin is the base. Keep the mold cold until the suppositories are hard, then remove.

For suppositories containing chloral hydrate, phenol, or other substances which soften the vehicle, raise the melting point by the addition of a small amount of spermaceti or other agent.

Suppositories of the shape for use in the urethra, nose, or ear are sometimes called bougies. Vagi-

nal suppositories are sometimes called pessaries.

The only official suppository is Glycerin Suppositories U. S. P.

CAPSULES

Capsules are gelatin shells containing solid or liquid medicinal substances to be taken internally. There are two types, hard and soft; and soft capsule shells are composed of gelatin, glycerin, and water, while the hard capsular shells have sugar and acacia added, with less water. It is advantageous to administer medicinal substances in capsules because:

1. They mask the taste of bitter drugs.
2. They can be given orally or rectally.
3. They are easily prepared.

Capsules cannot be used for aqueous or hydroalcoholic solutions which would dissolve the gelatin capsule.

Capsules are numbered in size from 000, the largest, to 5, the smallest. Trial weighings are necessary to tell which size to use. Capsules should be filled full, but not so full that the cap will not fit well down on the shoulder of the capsule. Generally the smallest size that will contain the drug is best to use. It is easier for the patient to swallow and gives a better appearance when full.

Each capsule should be weighed when it is being filled with a potent drug, but when nonpotent drugs are being used, a less accurate method is followed, which is to weigh the first three or four capsules filled and then an occasional one until the filling is completed. When potent drugs having a small dose are available in tablet triturates or hypodermic tablets, the tablets may be used to obtain the proper dose. A small bulk of active ingredients may be diluted with lactose to form a convenient amount of powder to handle in filling the capsules. Powders which do not pack well may be moistened with a few drops of alcohol to make them pack better.

EMULSIONS

An emulsion is a preparation containing two immiscible liquids, one of which is dispersed as globules in the other, with the aid of some emulsifying agent. The liquid that is broken into globules is called the dispersed or internal phase, and the liquid in which the globules are dispersed is known as the continuous or external phase.

The official emulsions are preparations containing oil dispersed in aqueous mediums. There are several theories of emulsification, but no one theory seems to be sufficient in itself. Each theory gives an explanation of some of the peculiarities of emulsions. The more nearly the dispersed phase approaches the colloidal state, the more stable the product will be.

The emulsifying agents are mucilaginous, albuminous, or saponaceous substances. For general pharmaceutical use, acacia is the best agent. There are three methods used in making emulsions:

Continental Method (Dried Gum Method)

A primary emulsion is prepared from definite proportions of oil, water, and gum. After the primary emulsion is formed, it can be diluted with the external phase. This method is also called the 4–2–1 method from the proportion of oil, water, and gum used in the formation of the primary emulsion. Four parts of oil and one part of gum are triturated in a dry mortar until thoroughly mixed. Two parts of water are then added all at one time and the mixture triturated rapidly. The emulsion is soon formed. A pronounced crackling sound indicates that the primary emulsion is formed. Several minutes of trituration at this point assures that the oil globules will be reduced to a minimum size. The remainder of the external phase is now added in small portions with thorough mixing between each addition.

English Method (Wet Gum Method)

The proportions of oil, water, and gum are the same as in the continental method. A mucilage is made with the gum and water, and the oil is added in small portions with continuous trituration to emulsify each portion before adding another. The primary emulsion is formed in this case when approximately one and one-half times as much fixed oil as mucilage has been added. The remainder of oil and water can then be added in divided portions.

Bottle Method

This method is generally used to make emulsions of volatile oils and other volatile liquids, although they may be prepared with the use of the mortar and pestle. Volatile cils and liquids usually require more emulsifier than fixed oils because they have a lower viscosity. About 15 gm. of acacia should be used for each 30 cc. of volatile liquid.

In the bottle method the 15 gm. of acacia are shaken in a dry bottle with 30 cc. of oil until the acacia is thoroughly "wetted" by the oil, 30 cc. of water is added all at one time, and the mixture is shaken vigorously until the primary emulsion is formed. Then the remaining water is added slowly, shaking vigorously after each addition.

Emulsions prepared by the bottle method are not generally as stable as emulsions of fixed oils.

Liniments

Liniments are alcoholic or oily liquids or semisolid preparations for external use, usually applied by friction.

Alcoholic solutions are used as bases for liniments because they are good solvents for many drugs; they penetrate the skin well and have a mildly rubefacient and astringent action. Fixed oils are good solvents for some rubefacient drugs; they furnish the necessary lubricating action for the liniment. Their ability to penetrate the skin is not so good as the alcohol bases, and consequently their action is milder.

Some volatile oils such as methyl salicylate and oil of turpentine are rubefacient and irritant in themselves and are employed alone, as solvents for other drugs, or combined with fixed oils to reduce their effect.

Mixtures

Mixtures are aqueous preparations containing insoluble, nonfatty substances for internal use. These preparations usually contain some suspending agent, such as acacia, tragacanth, or bentonite. The purpose of the suspending agent is: (*a*) To keep the insoluble matter suspended so a more uniform dose may be obtained; (*b*) to keep the suspended material in a more finely divided state; and (*c*) to make a more palatable preparation.

They differ from emulsions in containing no fats, and from liniments in being used internally. They should always be dispensed with a "Shake" label.

Infusions

Infusions are aqueous preparations made by maceration or percolation of vegetable or animal drugs with hot or cold water. Maceration is the process most commonly used. In the preparation of some infusions, the extracting solvent is applied cold, but usually it is poured on boiling hot. It is used cold for such drugs as wild cherry whose active principle, hydrocyanic acid, would be driven off by boiling water. Infusions do not keep well and should be made fresh when called for. This is one reason they are not popular.

When the strength of an infusion is not specified, the U. S. P. directs that the following formula should be used:

Drug, in coarse powder	50 gm.
Distilled water q. s.	1,000 cc.

Moisten the drug in a suitable closed vessel, preferably of earthenware, with 50 cc. of cold distilled water, and allow it to stand 15 minutes. Then add 900 cc. of boiling distilled water, cover the vessel tightly, and allow it to stand for 30 minutes. Strain the mixture and pass enough distilled water through the strainer to make the infusion measure 1,000 cc. If the activity of the drug is affected by the temperature of boiling water, use cold distilled water.

Digitalis Infusion N. F. is the only official infusion. It is made with Powdered Digitalis U. S. P. by using alcohol and cinnamon spirit in the menstruum. The dose is 6 cc.

Decoctions

Decoctions are aqueous preparations made by boiling drugs with water. There are no official decoctions.

Mucilages

Mucilages are aqueous preparations of mucilaginous, adhesive substances. They are somewhat soluble in water, but generally they are insoluble in alcohol. Usually the gum is not entirely soluble in water, but it merely absorbs water to form a thick gel. Mucilages should be freshly prepared, as they usually ferment when diluted with water.

Glycerites

Glycerites are mixtures or solutions of medicinal substances with glycerin. Glycerin is a good solvent for many substances, and its solutions do not deteriorate as do solutions of vegetable oils.

Extracts

Extracts are concentrated solid or semisolid preparations of the soluble active principles of drugs, usually prepared by percolation of the drug and evaporation of the percolate. They are prepared in three forms: Semisolid or of a syrupy consistency; plastic masses known as pilular or solid extracts; and dry powders known as powdered extracts. The three forms are interchangeable medicinally, but each has its pharmaceutical advantages. Powdered extracts are better adapted for incorporation into powdered preparations, while the semisolid or pilular extracts are preferred for such preparations as ointments, suppositories, and pills.

When the extract is to be adjusted to a definite strength, if the finished product is to be a powder, starch or lactose is used as the diluent, while soft extracts are diluted with glucose, sucrose, or lactose. There are no official color standards for extracts and they may vary considerably.

Triturations

Triturations are powders containing 10 percent active medicinal substance in lactose. Lower percentage triturations are sometimes prepared as stock preparations to assist in accurately weighing very small amounts of potent drugs. The proper procedure in preparing triturations, so that the medicinal substance is properly mixed, is to weigh the medicinal substance and lactose separately. Place the medicinal substance in a mortar, add about an equal volume of lactose, and mix well by trituration. Then add successive portions of lactose from time to time, mixing after each portion is added until the whole is uniformly mixed.

There are no official triturations, but many pharmacies keep them on hand for use in prescriptions.

Powders

Powders are mixtures of solid drugs in dry powder form. They are compounded in bulk and also in divided doses. They are a convenient form of administering insoluble substances, such as bismuth salts and chalk. In the dry state, many incompatible drugs may be prescribed together. Drugs which are bitter, corrosive, or which change on exposure to air cannot be administered in powders. Powders should be prepared in a state of fine subdivision. They may be mixed in various ways, on the pill tile with a spatula, with a mortar and pestle, by shaking in a paper bag, or with flour sieve. Potent drugs or small amounts of ingredients should be mixed well with about equal quantities of the diluent, and successive portions of the diluent added until all is thoroughly mixed.

When the ingredients are to be divided into individual doses, after they have been mixed, the pharmacist must choose the best method for dividing the powder into the required number of doses. In the case of potent drugs, great accuracy is essential. Weighing each powder is the most accurate method and should be used for all potent drugs. A less accurate method which is satisfactory for nonpotent drugs is to block and divide. In this procedure, the mixed powder is placed on the pill tile and formed into a square or a rectangle of uniform thickness. The square or rectangle is then cut into the desired number of sections with the spatula. Each section is separated and placed in a powder paper, folded properly, and dispensed in a box.

Magmas

Magmas are aqueous preparations of inorganic precipitates, in a fine state of subdivision, intended for internal use. The precipitation should be carried out in dilute solution to obtain the required fineness. The finer the precipitate, the better it will stay in suspension. These preparations should always be dispensed with a "Shake" label.

Lotions

Lotions are aqueous preparations, usually containing suspended insoluble matter, to be applied externally. They generally contain antiseptic substances useful in the treatment of skin diseases. Most lotions are suspensions or emulsions, but some are solutions.

Mucilages of gums such as acacia and bentonite are frequently used as thickening or suspending

agents for lotions containing finely divided matter.

Oleoresins

Oleoresins are liquid preparations of extracts containing volatile oil and resin, usually made by percolation and evaporation of the solvent from the dissolved oleoresins. Some oleoresins, such as turpentine and copaiba, occur naturally. The solvents most commonly used for extracting oleoresins are ether, acetone, and alcohol.

The strength of oleoresins is uncertain, since different samples of drugs contain different amounts of oleoresins. They represent, however, a very concentrated form of the drug, usually being from five to ten times stronger than the drug.

Resins

Resins are concentrated alcoholic extracts of drugs, made by percolation, evaporation, and precipitation in water. Natural resins are plant exudates, but the prepared resins contain some additional extractive matter.

Collodions

Collodions are liquid preparations of pyroxylin (gun cotton) in alcohol and ether. They are applied externally. The solvent readily evaporates, leaving a protective film of pyroxylin. Medicinal substances are frequently added to collodions for external medication.

Oleates

Oleates are chemical preparations of alkaloids or metallic oxides in oleic acid. They are prepared by dissolving an alkaloid or oxide in oleic acid with gentle heat.

The only official oleate is Mercury Oleate USP, which contains 25 percent yellow mercuric oxide in oleic acid.

Pills

Pills are globular or ovoid masses, each containing a definite amount of medicinal substances for oral administration. Their preparation in the pharmacy is nearly a lost art because of the introduction of machinery which can perform the work with much greater expedition and the increased use of compressed tablets and capsules.

The preparation of pills by hand is divided into three parts: Making the mass, dividing the mass, and rolling the pills.

In making the mass, the medicinal substances are triturated until uniform and worked into an adhesive, firm, semisolid form with the aid of some excipient such as glycerin, glucose, mucilage of acacia, or syrup. After the mass has been formed, it is rolled into a cylinder and divided into the proper number of units with the aid of a ruled pill tile or other means. The cut segments are rolled between the fingers and thumb until they are as round as possible. Handmade pills should be dusted with starch or lycopodium.

Troches or Lozenges

Troches or lozenges are thin, flat tablets of various shapes, containing medicinal substances, administered by slowly dissolving in the mouth, as a means of medication for the throat and mouth. Because of the method of administration, only tasteless or pleasant tasting substances are used in their preparation. They are made by forming a mass as for pills, rolling the mass out flat, and cutting with an appropriate cutter.

The only official troches are Penicillin Troches U. S. P. The U. S. P. states that they must comply with the requirements of the Federal Food and Drug Administration. The dose is one troche.

Tablets

Tablets are masses of medicinal substances, forced by compression into molds of various sizes and shapes. This is one of the most popular ways of administering drugs. In making tablets, it must be remembered that improper compression or blending of ingredients may affect their solubility, making it slow and difficult to dissolve them.

PRESCRIPTIONS

A prescription is a written order from the medical or dental officer directing the pharmacist to compound and dispense medicinal substances. The prescriptions are written in English, but some may be in Latin, or in English using some Latin terms.

The complete prescription is made up of the following parts:

1. Patient's name.

2. Date.
3. Superscription ℞.
4. Body of the prescription, which lists the ingredients and the quantities to be used.
5. Subscription, which is the doctor's instructions to the pharmacist for compounding and dispensing.
6. Signature, which is the directions to the patient.
7. Signature of the medical or dental officer.

On receiving the prescription, the pharmacist should study it carefully, checking the dose and compatibility. If he observes any ambiguity, incompatibility, or dangerous dose, or if for any other reason it is necessary to consult the medical officer, the patient should never be allowed to suspect that anything is wrong. The pharmacist should never dispense a prescription he does not completely understand, and he should always check the dose of potent drugs. What appears to be an overdose may be the proper dose for a certain patient, but the medical officer will appreciate being called to check the dose. The pharmacist has no authority to change the prescription without permission from the medical officer.

Young's rule of doses for children.—Calculate the fraction of the adult dose by dividing the age of the child by the age of the child plus twelve. For a child four years old, 4/4+12=4/16 or 1/4 of the adult dose.

When the pharmacist is sure he understands the prescription, he should give the compounding his undivided attention. It is good practice to write the label before filling the prescriptions, as it affords more time for considering the manner of compounding the doses. The label should be written plainly and neatly, preferably on the typewriter. Strict attention to the details of the prescription is the best method of avoiding mistakes in compounding. The labels on containers from which ingredients are removed should be read three times: (*a*) When the bottle is taken from the shelf; (*b*) before the contents are removed from the bottle; and (*c*) when the bottle is replaced on the shelf. (Poison) labels are best omitted except when a preparation is intended for external use. Even in this case, many physicians prefer "External Use Only." After the prescription is labeled, the ingredients should be checked by some systematic method. Each prescription should be numbered and filed in order. The date of compounding should always appear on the prescription.

The refilling of prescriptions which contain liquor, narcotics, hypnotics, or habit-forming and other dangerous drugs is prohibited by law. Restrictions on refilling may also be imposed by the medical officer, in which case he will mark the prescription "Non Rep." or "N. R." (nonrepeat). In many cases, however, refilling of the prescription is expected by the patient and medical officer.

FEDERAL NARCOTIC ACT

(Act of 17 December 1914 as amended at frequent intervals)

This is a law and contains regulations relating to the importation, manufacture, production, compounding, sale, dealing in, dispensing, and giving away of opium, or coca leaves, any compound, manufacture, salt, derivative, or preparation thereof.

Coca leaves include cocaine, mixture or preparation of coca leaves, except derivatives of coca leaves which do not contain cocaine, ecgonine, or substances from which cocaine or ecgonine may be synthesized.

Opium includes morphine, codeine, heroin, any compound, manufacture, salt, derivative, mixture, or preparation of opium.

An amendment provides for the discontinuance of manufacture and sale of heroin.

NARCOTIC PRESCRIPTIONS

The Narcotic Act provides for the issuance of prescriptions by duly licensed practitioners and exempt officials. The narcotic prescription must bear the following:

1. Date of issue.
2. Name and address of patient.
3. Registry number and address of practitioner.
4. Signature of the practitioner properly written in ink or indelible pencil.

The pharmacist is responsible for seeing that the prescription is properly made out before filling. Narcotic prescriptions cannot be refilled. It is permissible to partially fill a narcotic prescription, if the pharmacist is unable to supply the full quantity. In this case a notation should be

made on the face of the prescription indicating the amount furnished. A notation should also be made on the back of the prescription stating the reason for not furnishing the full amount. The medical officer should be notified of this change and no further quantity may be furnished the patient without a new prescription.

Furnishing of narcotics pursuant to telephone orders or advice of the medical officer is prohibited by the Narcotic Act, whether the prescription covering the order is subsequently furnished or not. Exceptions to this are made in cases of emergency, when the delivery of narcotics may be made but the prescription must be furnished before delivery.

Narcotic prescriptions are filed separately and are readily accessible to the investigating officer for inventory or other reasons.

The Narcotic Act states that the pharmacy must keep the prescription for 2 years. It is a better procedure to keep them longer.

The label on the prescription container must show the name and registry number of the pharmacy, the serial number of the prescription, the name and address of the patient, and the name, address, and registry number of the doctor writing the prescription. In the Navy it is not necessary for the medical officer or the pharmacy to be registered; therefore, the registration numbers are omitted, but regulations require that the medical officer sign the prescription with his name and rank.

Exempt Preparations

The Narcotic Act classifies, as exempt, preparations and remedies which do not contain more than the following:

Opium—2 grains per fluid ounce.
Morphine—¼ grain per fluid ounce.
Heroin—⅛ grain per fluid ounce.
Codeine—1 grain per fluid ounce.
Any salt thereof.

If preparations are solid or semisolid, the above amounts will pertain to the avoirdupois ounce.

The Act does not apply to liniments, ointments, or other preparations which are prepared for external use, except liniments, ointments, and other preparations that contain cocaine or any of its salts, alpha or beta eucaine, or any of its salts or synthetic compounds, and preparations containing pantopon.

The Narcotic Act states that exempt preparations shall contain active medicinal drugs, other than narcotics, in sufficient proportions to confer upon the preparation valuable medicinal qualities, other than those possessed by the narcotic drugs alone.

Use for aural, nasal, ocular, rectal, urethral, or vaginal purposes is not regarded as external use. Preparations used for such purposes containing more than the percentages of drug indicated in the exempt list are not within exemption.

There is no limit upon the percentage of narcotic drug that external preparations may contain, but the preparation must be unfit for internal use.

Exempt preparations may be dispensed with or without prescriptions, but they must be dispensed in good faith.

An extemporaneous prescription calling for narcotic drugs not in excess of the exempt amount may be refilled in the same manner as prescriptions calling for ready-made preparations or remedies, when the prescriptions are dispensed in good faith.

The Narcotic Act requires that when exempt preparations are dispensed, a record should be kept showing the date, the name and quantity of the preparation, the name and address of the patient, and the initials of the pharmacist dispensing the preparation.

NARCOTIC CONTROL IN THE NAVY

Navy regulations and the Manual of the Medical Department conforming with the Federal Narcotic Act govern the control of narcotics in the Navy. Medical officers are exempt from registration and payment of the narcotic tax. Prescriptions by exempt officials for narcotics must use official prescription blanks or official stationery.

Prescriptions may be filled for narcotic drugs which cannot be furnished from official stocks when it is necessary that they be obtained from civilian pharmacies using the Navy prescription. The prescriptions shall be used only by Army and Navy personnel and members of their families entitled to receive such treatment. This shall not apply in case of prescriptions written by Army and Navy medical officers in treatment of private patients, not entitled to receive medical treatment by the Army or Navy. Such prescriptions should

bear the signature, title, corps, and serial number of the issuing medical officer.

Prescriptions for narcotics are given separate narcotic numbers preceded by the letter "N" and filed separately from other prescriptions.

Orders for all narcotic drugs, including exempt narcotics, original or refill, must be on a written prescription signed properly by a medical officer with his rank.

Do not dispense narcotics to anyone before receiving a properly written prescription for them.

Various Medical Department activities have local regulations issued by Commanding Officers, Executive Officers, or Commandants of Naval Districts, governing the control of narcotics. The man in charge of the pharmacy should familiarize himself with these regulations and adhere strictly to them.

As soon as narcotics are received in the pharmacy, they should be taken up in the Narcotic Ledger.

Narcotic Ledger

This ledger should be a record of all receipts and expenditures of narcotics as occurring in the pharmacy.

Enter all receipts in red ink and expenditures in black ink. Avoid erasures and errors. Keep a neat ledger.

Make entries daily and do not allow prescriptions to accumulate. Take a weekly inventory of all narcotics, usually before captain's inspection. The ledger may be set up as follows:

Date	Rx No.	Amount received	Amount expended	Balance

Use a separate page for each item, and place at the head of the page the following information: Full name of the item as it appears in the Catalogue of Medical Matériel or if it is requisitioned on open purchase, stock number, size of container and unit, if tablets—size of tablets and number in container and unit, if ampoules or syrettes—amount in ampoule or syrette and size of unit. Allow sufficient pages between items. Record liquids and solids in metric or apothecary system. Record tablets by single tablets. Record ampoules and syrettes by single ampoule or syrette.

Enter prescriptions in numerical sequence.

Alcohol Regulations

Navy regulations and the Manual of the Medical Department govern receipts and expenditures of alcohol and intoxicating liquors.

Intoxicating liquors, including alcohol, shall be kept under lock and key and shall be used only in connection with the treatment of sick, or to meet essential requirements of medical department activities.

Receipts and expenditures of alcohol and intoxicating liquors must be recorded properly and close inventory kept.

Alcohol in the Pharmacy

All prescriptions for alcohol should be signed by a medical officer.

All prescriptions for alcohol for use in manufacturing in the pharmacy should show the amount of alcohol used and the purpose for which it was used.

A separate file should be kept for alcohol prescriptions. They should be numbered in sequence and each number preceded by the letter A.

Prescriptions for alcohol shall not be refilled without a new prescription from the medical officer.

Intoxicating Liquors in the Pharmacy

Prescriptions for whisky, brandy, or wine are usually approved and signed by the executive officer before filling.

A separate file is kept for whisky, brandy, or wine in numerical sequence, the number preceded by the letter W.

Necessary precautions should be taken that this item is dispensed to responsible persons.

A record of receipts and expenditures of alcohol and intoxicating liquors is kept on a ledger set up in the same way as the Narcotic Ledger.

Poison Regulations

The new Federal Food, Drug, and Cosmetic Act of 25 June 1938, preserves all the worthy features of the Federal Food and Drugs Act of 30 June 1906.

With respect to drugs, it brings under control drugs used in the diagnosis of disease and drugs intended to affect the structure or any function of the body.

Following are the important parts of the new regulations:

1. It prohibits traffic in drugs and devices which are dangerous to health under the conditions of use prescribed in the labeling.

2. It prohibits traffic in new drugs unless such drugs have been adequately tested to show that they are safe for use under the conditions of use prescribed in the labeling, but authorizes exemption from this requirement of drugs intended solely for investigational use by qualified scientific experts.

3. It requires labels of official drugs to reveal any differences of strength, quality, or purity from the official standard.

4. It requires drugs intended for use by man to bear labels warning against habit formation if they contain any of the list of narcotics or hypnotic habit-forming substances, or any derivative of any such substance which possesses the same properties.

A drug shall not be considered to be mislabeled by reason of failure of its label to bear the statement "Warning—may be habit forming."

(*a*) If such drug is not suitable for internal use, and is distributed and sold exclusively for external use or involves no possibility of habit formation.

(*b*) If the only substance or derivative subject to the regulation is chlorobutanol when present solely as a preservative in quantity not more than 0.5 percent by weight and such drug is for parenteral use only.

(*c*) If the only substance or derivative subject to the regulation is chlorobutanol, which is present as an analgesic and preservative in quantity not more than 3 percent, and such drug contains one or more other active ingredients and is for parenteral use only.

5. It requires the labels of drugs to bear warnings against probable misuse which may be dangerous to health.

6. It requires special precautionary labeling for drugs that are liable to deterioration. It requires official drugs to be packaged and labeled as prescribed by the Pharmacopoeia and National Formulary.

7. It requires that antiseptics possess germicidal powers.

8. It requires the labels of nonofficial drugs to list the names of the active ingredients, and in addition to show the quantity or proportion of certain specified substances. It authorizes regulations prescribing exemptions from this requirement where compliance is impracticable.

Information concerning drugs that should be dispensed only to or upon the prescription of a medical officer or dental officer

The new law places upon the manufacturer and the distributor the responsibility for properly safeguarding the marketing of drugs which may be dangerous to the user if distributed without restriction.

Obviously, it is impossible to list all drugs which may be dangerous, since not only the compositions but also the directions for use and the conditions in which their use is recommended may have a very definite bearing on the question of safety or danger. As examples of drugs which are considered dangerous when distributed for use otherwise than on prescription, the following have been mentioned:

Aconite; aminopyrine; barbiturates; benzedrine sulfate (for internal use); cantharides (for internal use); chrysarobin; chrysophanic acid; cinchophen, neocinchophen, and other cinchophen derivatives; colchicine; colchicum; digitalis; phosphides; phosphorus; radium; squill; strophanthus; sulfonamides; tansy, tansy oil; thiocyanates; thyroid; the anthelmintic drugs; carbon tetrachloride, tetrachloroethylene, male fern, santonin, worm seed oil, and thymol.

Bromides: If the dosage provided involves the consumption of more than 30 grains per day or more than 15 grains during any 3-hour period.

Acetanilid: In the case of medicines that provide a total daily intake of more than 5 grains or more than 2½ grains during any 3-hour period.

Epinephrine in solution of 1 percent or stronger.

Ipecac in daily dosage greater than 10 grains.

Strychnine in a daily dose greater than 1/20 grain.

Where the so-called prescription legend **"Caution.**—To be used only by or on the prescription

of a physician" appears upon the package in lieu of directions for use, it is the obligation of the dispenser to observe the injunction that the article be dispensed only upon prescription.

Poison Regulations (In The Navy)

The dispensing of poisons in the Navy is governed by the Manual of the Medical Department.

Poisonous drugs are dispensed only on a prescription signed by a medical or dental officer.

Bichloride of mercury tablets shall be issued only in the form supplied by the supply depot.

All solutions of bichloride of mercury ($HgCl_2$) shall be tinted blue.

All persons of the medical department shall be duly warned regarding the dangers of accidental poisoning and instructed in the proper handling of poisons.

All prescriptions for poisonous drugs shall be numbered and filed in the regular prescription file.

Prescriptions need not have "Poison" marked on the container if they carry specific directions as ordered by the doctor.

Poisons issued to wards should have poison labels, and if for external use, they should have "External use" labels.

INCOMPATIBILITY

In pharmacy, the term incompatibility is used to designate substances which are opposed to each other for one reason or another. Incompatibilities may be pharmaceutical or physical, chemical, or therapeutic. It is practically impossible to compile a complete list of incompatibilities which might occur in prescriptions so long as new combinations of drugs and new drugs continue to be manufactured.

Pharmaceutical Incompatibilities

Pharmaceutical or physical incompatibilities are usually due to insolubility, and a knowledge of the general characteristics of the solvent and the solubility of the solute is of great help in avoiding them. A few general methods of preventing physical incompatibilities include:

1. **Order and manner of mixing.**—When compounding a prescription, the first thought should be the order of mixing. The solid ingredients should first be dissolved in the solvent in which they are most soluble before adding other solutions. The liquid in which the troublesome ingredient is least soluble should be added slowly and with constant stirring.

2. **Altering the solvent.**—This means the use of a solvent in greater or less proportion than is directed, without changing the final volume of the mixture. Water will dissolve most of the common salts, inorganic or organic, sugars, gums, mucilages, tannins, albumins, and proteins. Alcohol dissolves most natural organic medicinal substances and many of the organic synthetics. Many organic substances, such as alkaloids, are in the form of salts, and are therefore soluble in water. Most of the acetates, benzoates, nitrates, salicylates, bromides, iodides, and some chlorides are soluble in alcohol. Most of the inorganic salts are not soluble in alcohol.

3. **Changes in the total volume of the mixture.**—This method of treatment applies particularly to salt solutions and to mixtures containing alkaloids. It is applied in those cases where the mixture contains some substance which will be damaged or thrown out of solution by a high concentration of one or more of the other ingredients. In many cases the question rests upon the proportion or relative strengths of the solutions. When this method is used, care must be taken to see that both the patient and the medical officer understand that a change in volume and a corresponding change in dose have been made.

4. **Addition of solvent acting salts.**—A common example of this change is the addition of a soluble iodide to effect the solution of iodine or of mercuric iodide in water. The amount of iodide needed in this case is about twice the amount of iodine or mercuric iodide. Sodium citrate aids in dissolving oxides and hydroxides of iron, manganese, bismuth, and copper, and also aspirin. Citric and tartaric acid increase the solubility of boric acid and borates. Mineral acids increase the solubility of quinine sulfate in water. Alkalies affect the solubility of many resins in water. Alkaloid salts are insoluble in oils, but the free alkaloid is soluble in oil.

5. **Suspension or emulsification of certain ingredients.**—This is used when the precipitate formed is not in a fine condition and diffusible state. The manner of mixing liquids which pre-

cipitate has much to do with the condition of the precipitate. When a solution containing a resin is to be mixed with a water solution, if the proportion of the resin solution is rather small and it is added slowly to the water solution, a fine milky suspension is obtained. If it is added fast, or in large quantities, an emulsifying agent is needed to prevent the resinous precipitate from coagulating and sticking to the sides of the bottle.

6. **Addition of inert material.**—The formation of a liquid or pasty mass as a result of mixing two or more dry powders is usually overcome by the use of some inert absorptive material such as dried starch.

Therapeutic Incompatibilities

The most important consideration in this class of incompatibility is dangerous doses. The pharmacist must detect dangerous doses and see that they are corrected by the physician before the prescription is filled. In case of doubt, the dose should always be verified. The U. S. P. and N. F. doses are average doses, and the dose of certain drugs may vary considerably from the official dose, depending on the size and physical condition of the patient. The frequency with which the drug is administered is to be considered. Most drugs act more powerfully when given parenterally than when given by rectum or orally, and most drugs act more powerfully when administered orally than by rectum. There are exceptions to this. Strychnine is more active when given rectally than by mouth. Certain drugs increase the toxicity of other drugs.

Chemical Incompatibilities

Chemical incompatibility is usually noticed in one of three ways: The formation of a precipitate, effervescence, or color change. Precipitation is the most common, and it may occur immediately when two liquids are mixed, or it may take some time for the precipitate to form. Precipitation of a solution is undesirable because the dose of such a mixture is hard to control. Incompatibilities of this kind cannot always be avoided, and the preparation must be dispensed with a "Shake" label. The pharmacist should use his skill to make the precipitate as fine as possible and if necessary use a suspending agent.

Gaseous solutions are sometimes ordered purposely, but in prescriptions, the evolution of a gas is more likely to be unintentional, in which case it may be troublesome. A slow effervescence may be particularly annoying unless carefully controlled. Unless some means of hastening the reaction is used, a pressure may develop in the bottle, causing it to break or overflow when opened. Vigorous shaking or heat is a means of hastening the evolution of gas.

There are three kinds of color change to consider: Those caused by the age of the preparation and the exposure to light, those due to difference of quality or character of the chemical or drug, and those which result from a chemical reaction. If the pharmacist knows or suspects that a color change may take place on ageing, he should explain this fact to the patient when he receives the prescription so that his suspicions will not be aroused when he notices the change.

If different sources of chemicals or drugs from time to time may cause a change in the color of the prescription, a notation may be put on the prescription when it is filled, indicating what chemical or drug was used.

Changes in color caused by chemical reaction are more common. New combinations of drugs are continually increasing the pharmacist's knowledge of these changes. They are usually caused by very delicate reactions, and from a therapeutic point of view are usually unimportant. Uniformity in color, however, is important because of its influence on the trust of the doctor and patient in the pharmacist. Some color changes are produced slowly, and the pharmacist should know them, so that he can forewarn the patient and doctor or explain the difference in appearance after it is noticed.

Common Incompatibilities

Acacia.—Alcoholic solutions precipitate acacia from mucilages. Dilution of the mucilage or the alcoholic solution with water will prevent precipitation. Acacia mucilage is gelatinized by solution and tincture of ferric chloride, solution of ferric sulfate, ferric subsulfate, iron and ammonium acetate, and lead subacetate, and by saturated solutions of sodium borate. The gelatinization may be prevented by diluting the mucilage with

several volumes of water or small amounts of glycerin or syrup.

Acacia contains a ferment which produces a color change with many substances, either immediately or on standing. If the solution of acacia is heated to 100° C. for 1 hour, the ferment is destroyed, and the color reactions are avoided.

Acetanilid.—Powdered acetanilid forms a liquid or damp powder, according to the proportions, when triturated with aspirin, antipyrine, chloral hydrate, menthol, phenol, resorcinol, salol, or thymol. In solution it develops a yellow, red, or green color with oxidizing agents, such as ethyl nitrite spirit or ferric chloride tincture. This may be prevented by making the solution slightly alkaline. Acetanilid is decomposed in solution by strong alkalies.

Acetates.—All of the common acetates are soluble in water. They are weak combinations and hydrolyze readily in solution, losing acetic acid. In the case of alkaloidal acetates, loss of the acid causes the formation of the less soluble basic forms, and these may precipitate from solution. The addition of a small amount of acetic acid to these substances usually overcomes the precipitation.

Acetic acid partially displaces carbonic acid from its salts and is itself displaced by mineral acids. Glacial acetic acid dissolves resins, oils, and many insoluble organic substances. A deep red color is produced with ferric salts and an excess of acetic acid, disappearing on the addition of mineral acids.

Acetophenetidin (Phenacetin).—When mixed with chloral hydrate, acetophenetidin liquefies. In solution it gives a yellow, pink, purple, or red color with the stronger oxidizing agents. It forms a liquid or pasty mass when triturated with aspirin, aminopyrine, chloral hydrate, or phenol.

Acetyl Salicylic Acid (Aspirin).—It is decomposed by water and by alkalies, producing acetic acid and salicylic acid or their salts. When triturated with antipyrine, methenamine, or phenol, a sticky mass is produced.

Acids, Organic.—All the organic acids are displaced from their salts by mineral acids.

Alcohol.—Albumins, gums, most sulfates, and some other mineral salts are precipitated by excess alcohol. With chloral hydrate, chloral alcoholate is formed and may separate as an insoluble liquid.

Alkaloids.—Many of the common incompatibilities met in prescription work are due to alkaloids. They form salts with acids which are usually soluble in water, the solution having a neutral reaction. The free alkaloids are almost insoluble in water and have an alkaline reaction. They are usually rather soluble in alcohol, ether, chloroform, and other organic solvents, while the salts are less soluble in alcohol and are usually insoluble in ether or chloroform. Since most alkaloidal salts are soluble in water, while the free alkaloids are not, alkaloids are usually prescribed as salts. Solutions of salts are precipitated by alkalies and alkaline solutions. Methenamine, acting as an alkali, precipitates alkaloids. Iodine precipitates all the alkaloids. The precipitation is more complete from acid solutions. Some salts form insoluble compounds with alkaloids. Combinations of this type are mercuric chloride or iodide with potassium iodide, forming potassio-mercuric iodide, which precipitates nearly all alkaloids from very dilute solutions. Tannic acid forms insoluble tannates, particularly if the solution is slightly but not strongly alkaline.

The precipitation of alkaloids may be prevented by the addition of alcohol. Mucilage of acacia, syrup, and glycerin also help to prevent their precipitation. Some alkaloids act as reducing agents and will reduce mercuric chloride to calomel. Practically all will reduce silver nitrate.

Aloe and Aloin.—Solutions are colored black with ferric chloride and red with spirit of ethyl nitrite.

Aminopyrine (Amidopyrine, Pyramidon).—The incompatibilities are similar to those of antipyrine. It is precipitated by most of the alkaloidal reagents. Aminopyrine produces a blue color with oxidizing agents. It forms a soft mass when triturated with phenol, chloral hydrate, citric acid, tartaric acid, or salicylic acid. The mixture with aspirin or salol becomes yellow.

The continued use of aminopyrine is liable to cause serious blood degeneration which may be fatal.

Antipyrine.—It liquefies when triturated with phenol, chloral hydrate, acetanilid resorcinol, thymol, or salol. It acts on calomel in the presence of moisture, darkening it and partially converting it to mercuric chloride and metallic mercury. In solution with ferric chloride, a red

color is produced. With spirit of ethyl nitrite, a green color is produced. Aqueous solutions of antipyrine are precipitated with most alkaloidal reagents.

Arsenates.—Most arsenates are insoluble, except the alkali arsenates. In acid solutions, arsenates act as mild oxidizing agents. They are easily reduced to arsenates.

Arsenic Trioxide.—Solutions of arsenic trioxide are precipitated with ferric hydroxide, potassium iodide, or tannic acid. Arsenous acid is very slowly soluble, even in hot water. Its solubility is aided by hydrochloric acid and by alkalies.

Arsenites.—Arsenites act slowly as reducing agents and are oxidized to arsenates. Exposure to air partially oxidizes solutions of arsenous acid and potassium arsenite. Fowler's solution is alkaline and has the usual incompatibilities of alkalies.

Balsams.—They are insoluble in water, but a certain amount of the resinous matter can be dissolved in alkaline solution. Most balsams are partially soluble in alcohol. They are precipitated from alcoholic solutions with water. Balsam of Peru often gives trouble when an attempt is made to incorporate it with a fatty base. This may be overcome by the use of solid petroxolin, in which it is soluble, or an equal amount of castor oil.

Barbiturates.—The parent substances are soluble in alcohol and are precipitated from these solutions with water. The salts are soluble in water, somewhat soluble in alcohol, and are decomposed and precipitated by acids. The solutions of the salts are stable if the solutions are alkaline.

Benzoates.—Solutions of benzoates are decomposed by strong acids, forming benzoic acid. The solutions precipitate ferric salts in neutral solution.

Betanaphthol.—It produces a damp powder or a liquid when triturated with antipyrine, camphor, phenol, menthol, or salol. Aqueous solutions give a green color with ferric chloride, turning brown on standing.

Bicarbonates.—The common bicarbonates are soluble in water and insoluble in alcohol. They are easily changed to carbonates by dry heat above 50° C. and by lower temperatures when in solution. For this reason they should be dissolved carefully when dispensed. They are decomposed by mineral acids, less completely by organic acids, and partially by boric acid.

Borates.—The alkali borates may precipitate alkaloids from solutions of their salts. They precipitate most of the metals and the insoluble borate. Strong solutions will cause mucilage of acacia to gelatinize. An important characteristic of borax is that it is very soluble in glycerin, and its reaction is changed from alkaline to acid in glycerin. The solubility of boric acid in water is greatly increased by benzoic, tartaric, or salicylic acid or their alkali salts.

Bromides.—The soluble alkali bromides precipitate some alkaloids. This is best overcome by adding about 20 percent alcohol. Strong oxidizing agents may liberate free bromine from the bromides.

Soluble bromides should never be dispensed in combination with mercurous salts because of the possibility of the formation of toxic mercuric bromide.

Camphor.—Camphor, mixed with menthol, resorcinol, salol, phenol, chloral hydrate, benzoic acid, salicylic acid, betanaphthol, or thymol in about equal quantities, will produce a soft mass or liquid.

Camphor is slightly soluble in water but is thrown out of solution by small amounts of soluble salts, but it is easily precipitated with water or glycerin. It forms unstable compounds with iodine.

Carbonates.—Alkali carbonates are all insoluble except those of the alkali metals. Carbonates are all decomposed by mineral acids, less completely by organic acids, and only partially by boric acid.

Chloral Hydrate.—It is freely soluble in water, alcohol, ether, chloroform, glycerin, acetone, fixed and volatile oils, and fats. Aqueous solutions dissolve acetanilid, alkaloids, benzoic acid, salicylic acid, some volatile oils, resins and starch. Aqueous solutions decompose slowly on exposure to light.

Alkalies decompose chloral hydrate into chloroform and alkali formate. Sodium bicarbonate or aromatic spirit of ammonia decomposes it. It is also decomposed by free alkaloids, methenamine, and borax. Easily hydrolyzed salts; such as barbital sodium, in combination with chloral hydrate, will slowly decompose it, forming chloroform and

formic acid. It decomposes slowly in solution with potassium iodide, sodium bromide, or magnesium sulfate, chloral alcoholate is formed, which separates as an oily liquid. In the presence of alcohol alone, the chloral alcoholate may form and remain in the solution.

Chloral hydrate liquefies or produces a pasty mass when triturated with a number of organic substances. It softens cacao butter and may liquefy suppository mixtures. This may be overcome by the addition of 4 to 5 percent of wax or 8 to 10 percent of spermaceti.

Chloramine — Chloramine — T.—It liberates chlorine slowly on exposure to air. Mineral acids decompose it rapidly. It liberates iodine from soluble iodides and bromine from bromides on the addition of mineral acids.

Chlorates.—Chlorates in powdered or crystalline form react violently if triturated with organic matter. They are decomposed by strong mineral acids.

Chlorate solutions in the presence of acids are powerful oxidizing and bleaching agents.

Chlorides.—All the chlorides are soluble in water except bismuth, lead, mercurous, and silver chloride. Strong hydrochloric acid partially converts calomel to mercuric chloride, but dilute acid and soluble chlorides have no effect upon it.

Chlorobutanol (Chloretone, Chlorbutol, Methaform).—It is decomposed by weak acids or alkalies. It liquefies when triturated with an equal weight of phenol, menthol, or antipyrine. It is freely soluble in alcohol, chloroform, acetone, ether, and glycerin. Chlorobutanol contains one-half molecule of water of crystallization, which forms a cloudy solution when dissolved in liquid petrolatum. This may be overcome by dissolving the chlorobutanol in warm liquid petrolatum and filtering the oil through filter paper. This filtering process is slow, and a stock solution should be made and kept on hand for compounding prescriptions.

Cinchophen.—It is administered mostly in powder or tablet form, usually without admixture. It is almost insoluble in water and alcohol and dissolves in alkali solutions, forming soluble salts.

It is not highly toxic, but its continued use is irritating to the liver, producing jaundice in some patients.

Collodion.—It is easily precipitated with water. Collodion containing some water may decompose, the pyroxylin being rendered acid and irritating. The pyroxylin is also decomposed by alkalies.

Creosote.—It is only slightly soluble in water but is freely soluble in alcohol, ether, and chloroform. It is very soluble in glycerin, but practically insoluble in a mixture of glycerin and water. It precipitates acacia and albumin but not gelatin. An alcoholic solution produces a bluish-green color with ferric chloride. Trituration with a strong oxidizing agent may cause an explosion. With acids it forms creosote carbonate.

Epinephrine (Adrenalin).—It is readily oxidized, becoming inert and pink to red in color. It is precipitated from acid solution by alkali hydroxides or carbonates. Iodine produces a pink color. Ferric chloride produces a green color.

Ethyl Nitrite Spirit (Nitrous Ether Spirit).—It is very easily hydrolyzed by water and usually shows nitrous acid. Ethyl nitrite may be thrown out of solution when the spirit is mixed with strong salt solutions. It is rapidly decomposed by water, exposure to air or light, and alkalies. Alcohol contains enough water to hydrolyze it on standing, at ordinary temperatures and in the light. The nitrous acid so liberated acts either as a reducing or an oxidizing agent. It liberates iodine from iodides and bromine from ammonium bromide. It oxidizes sulfites and hypophosphites and reduces permanganates. It reduces mercuric salts but may oxidize mercurous salts.

Ethyl nitrite spirit produces a green color with antipyrine, a green or brown with thymol a yellow with acetanilid or morphine, and a red with salicylates or phenol. With tannic acid and some drug extractives, it reacts slowly, giving off nitrogen oxides. This incompatibility and the color changes can be prevented by rendering the spirit alkaline before mixing, but this decomposes the ethyl nitrite.

Eutectic Mixtures.—These are most troublesome in powders but sometimes give trouble in liquids because the mixture formed is insoluble. It may be necessary to add a little fixed oil and acacia to act as an emulsifying agent. In powders, or suspensions the difficulty may be overcome by avoiding pressure or heat in mixing. In solutions it is not a question of the solubility of the indi-

vidual ingredients but the solubility of the eutectic formed.

Formaldehyde.—The solution polymerizes to paraformaldehyde when pure. For this reason, the official solution contains some methyl or ethyl alcohol. The solution will polymerize when standing in a cool place.

Formaldehyde unites with ammonia to form solid hexamethylenetetramine. It is decomposed by strong alkalies, forming methyl alcohol and a formate. It forms insoluble compounds with albumin, casein, gelatin, agar, starch, and alkaloids. Formaldehyde is a powerful reducing agent, especially in alkaline liquids. It is oxidized to formic acid with oxidizing agents.

Gelatin.—It swells but does not dissolve in cold water, but dissolves slowly in hot water. It gelatinizes on cooling, which may be prevented by the addition of acetic or nitric acid, or by long heating. It is precipitated from solutions with tannic acid, alcohol, picric acid, and chlorine water. Gelatin increases the solubility in water of slightly soluble substances, such as camphor, alkaloids, benzoic acid, and salicylic acid.

Glycerin.—When undiluted it forms explosive compounds with oxidizing agents. When diluted with water, it is decomposed with oxidizing agents. It is not a good solvent for camphor, menthol, resins, or volatile oils. It is a good solvent for boric acid, borates, phenol, some phenol compounds, creosote, and guaiacol.

Glycerin usually contains iron as an impurity, which will cause a slow darkening of mixtures of tannin, phenols, eugenol and salicylates. These discolorations can be prevented by a small amount of sodium citrate. The presence of fatty acids as impurities may cause the development of unpleasant odors and taste in acid mixtures.

Glycerophosphates.—Sodium, potassium, and ammonium glycerophosphates are soluble in water but insoluble in alcohol. Calcium, magnesium, and strontium glycerophosphates require the presence of citric or phosphoric acid to make them soluble, while iron and manganese glycerophosphates are made more soluble by sodium citrate. Heat or alkalies slowly decompose glycerophosphates. Glycerin and sugar will retard this decomposition.

Glucosides.—Glucosides are decomposed by mineral acids, very slowly in weak solutions and more quickly in hot solutions. Water favors their decomposition, while alcohol protects them from change. Alkalies favor decomposition. Tannic acid precipitates most glucosides.

Hydroxides.—The fixed alkali hydroxides precipitate free alkaloids from solution, as does ammonia water. Sucrose and glycerin prevent precipitation of some of the metallic hydroxides. All hydroxides react with acids to form salts. They all decompose certain organic substances, such as esters, glucosides, chloral hydrate, and others.

Hypophosphites.—Most of these are slowly soluble in water and insoluble in alcohol. They are strong reducing agents, and trituration with oxidizing agents may result in an explosion. Salts of mercury, silver, and bismuth are reduced by hypophosphites.

Solutions of hypophosphites are more stable when sugar or glycerin is present, but excess sugar will precipitate them.

Ichthammol, Ichthyol.—These are soluble in water and glycerin. Alkalies liberate ammonia, and acids precipitate a resin from them. Calomel, resorcinol, and potassium iodide form insoluble compounds. When they are incorporated into ointments, lanolin aids in obtaining a homogeneous mixture.

Iodides.—All the iodides are soluble in water except cuprous, lead, mercury, and silver salts. Most of the soluble iodides are less soluble in alcohol. Most of the insoluble iodides are soluble in solutions of potassium, sodium, or other soluble iodides. Iodine is also soluble in solutions of iodides.

The soluble iodides precipitate many alkaloids. This can usually be prevented by increasing the alcohol content to about 20 percent. Alkalinity of salts may sometimes account for the precipitation of alkaloids.

Iodides are decomposed by strong light, liberating iodine. Iodine is liberated rapidly in acid solution, so iodides should be dispensed in neutral or slightly alkaline solution. Sugar may stabilize solutions of iodides even in acid solution; for this reason the official Syrup of Ferrous Iodide is rather stable. Oxidizing agents liberate iodine from solutions of iodides.

Iodine.—Iodine oxidizes hypophosphites, sulfites, and in the presence of alkali, the lower valence salts of iron, arsenic, antimony, and mer-

cury. Mercurous salts are also oxidized in acid solution. With ammoniated mercury or ammonia water iodine may form an explosive iodide of nitrogen. It reacts with some fixed oils to form additional compounds. It reacts with turpentine with almost explosive violence. In alcoholic solution, iodine slowly forms hydrogen iodide if potassium iodide is absent. It precipitates nearly all akaloids. The precipitation can sometimes be avoided in a high concentration of alcohol.

Iodoform.—Iodoform is slowly decomposed by tannins or balsam of Peru to form odorless derivatives. It is oxidized in sunlight to carbon dioxide, iodine, and water. Mixed with fats, it undergoes similar reactions. On exposure to light, a mixture of iodoform and calomel is colored red because of the formation of red mercuric iodide.

Menthol.—It is decomposed by strong oxidizing agents. Menthol is almost insoluble in water or glycerin and soluble in alcohol, ether, chloroform, glacial acetic acid, and fixed and volatile oils. It liquefies or forms a soft mass when triturated with chloral hydrate, camphor, betanaphthol, phenol, resorcinol, thymol, or urethane.

Mercuric Chloride.—It is a general alkaloidal precipitant. It is reduced to calomel and then to mercury by metallic zinc, copper, or iron in solution. In alkaline solution, the reduction occurs in the presence of soluble arsenites, antimony, and potassium tartrate, ferrous salts, and light. It is precipitated from solution by fixed alkali hydroxides. Solutions of mercuric chloride are precipitated by ammonia water and ammonium carbonate to form ammoniated mercury. Mercuric chloride is also precipitated by potassium or sodium carbonate or bicarbonate and by sodium borate.

Mercuric Iodide.—It is reduced under the same conditions as mercuric chloride and the incompatibilities are similar.

Mercuric Oxide.—Ointment of mercuric oxide darkens in time because of slow reduction. Rubbing with reducing agents will also cause it to darken. Yellow mercuric oxide is reduced with cocaine hydrochloride, forming mercuric chloride. The incompatibilities of red mercuric oxide in ointment are similar to those of the yellow oxide.

Mercurous Chloride.—A precipitate of black mercurous oxide results from the addition of potassium, sodium, or calcium hydroxide to mercurous chloride. It is reduced to metallic mercury by nitrous compounds, such as spirit of ethyl nitrite and hypophosphites, and in alkaline mixtures by arsenites and tartar emetic.

Mercurous Iodide (Yellow).—The incompatibilities are similar to those of calomel.

Methenamine.—It is alkaline in reaction and forms salts with weak organic acids. Mineral acids and strong organic acids decompose it, forming formaldehyde. It may precipitate alkaloids from strong solutions. It shows the usual incompatibilities of alkalies. It precipitates ferric salts, is precipitated by tannic acid, and reduces mercury and silver salts. It combines with gelatin or formaldehyde, forming an insoluble mass. Methenamine combines with and dissolves cinchophen. Ammonia salts and alkalies darken it. It liquefies when triturated with aspirin. Solutions are decomposed by boiling.

Oleoresins.—Oleoresins have the incompatibilities of both oils and resins. They are precipitated by water. When dispensed in water, they must be suspended or emulsified. They are soluble in ether.

Oxides.—The oxides of barium, calcium, magnesium and strontium hydrolyze in water to form hydroxides, which absorb carbon dioxide to form carbonates. The oxides of the metals are all insoluble in water, with the exception of arsenous and chromic oxide.

Permanganates.—Most of the permanganates are soluble in water. They are powerful oxidizing agents, acting on all organic matter. Permanganates should not be triturated with other substances in the dry form, as an explosion may result with oxidizable substances. They are incompatible with almost all other pharmaceutical materials and are best dispensed alone.

Phenol.—Phenol is soluble in water and glycerin without heat. It is very soluble in alcohol, chloroform, ether, and petrolatum. Ointments or oil solutions are best prepared by dissolving pure phenol in the ointment base or oil.

Phenol precipitates albumin and gelatin unless the gelatin is in excess. It precipitates pyroxylin from collodion. Phenol is precipitated by lead subacetate, but not by lead acetate. It is precipitated by bromide, but not by iodine. Exposure to air gradually turns it red. Strong nitric acid forms picric acid with phenol. Ferric chloride in

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neutral solution gives a green, blue, or violet color. Phenol reduces salts of mercury, silver, and copper. It produces a liquid or soft mass when triturated with acetamide, acetanilid, phenacetin, aminopyrine, antipyrine, betanaphthol, camphor, chloral hydrate, menthol, terpin hydrate, thymol, caffeine, and some other alkaloids.

Phenolphthalein.—It is almost insoluble in water but readily soluble in alkaline solution, giving a deep red color. It is decomposed by reducing agents in alkaline solutions.

Phenyl Salicylate (salol).—Dilute solutions of ferric chloride produce a violet color in alcoholic but not in aqueous solutions. It is almost insoluble in water. It is hard to powder with a mortar and pestle, but this may be overcome by moistening with a few drops of ether. Phenol salicylate is best dispensed by dissolving in oil and emulsifying the solution or by dissolving in ether, mixing this solution with acacia or tragacanth, allowing the ether to completely evaporate, then triturating the mixture with water.

It liquefies or produces a damp mass with barbital, camphor, chloral hydrate, phenol, terpin hydrate, thymol, or urethane.

Phosphates.—All phosphates are soluble in hydrochloric or nitric acid. The phosphates of the alkali metals and ammonia are soluble in water. All are soluble in solutions of alkali citrates. The monophosphates dissolve to form acid solutions, the diphosphates, slightly alkaline, and the triphosphates, basic.

Resins.—All resins are soluble in alcohol and insoluble in water. Some are soluble in fixed oils. Most of them are soluble in potassium, sodium, or ammonium hydroxide. Alcoholic solutions of resins give color reactions with hydrochloric acid or ferric chloride. Most resins soften or liquefy when mixed with camphor, menthol, phenol, salol, thymol, or urethane.

Resorcinol.—Resorcinol is soluble in water, alcohol, or glycerin. Solutions are colored violet by ferric chloride and dark red by spirit of ethyl nitrite. Resorcinol darkens on exposure to light and air, becoming pink when dry and brown in solution. Various color changes are produced with many organic compounds.

Resorcinol forms a liquid or soft mass when triturated with acetamide, acetanilid, antipyrine, camphor, chloral hydrate, menthol, or phenol. Strong aqueous solutions act as a solvent for camphor, menthol, and salicylic acid.

Salicylates.—Most salicylates are water soluble. Salicylic acid and quinine salicylate are slightly soluble. The soluble salicylates, when added to an aqueous solution of quinine sulfate, produce insoluble quinine salicylate. Mineral acids and some organic acids liberate salicylic acid when added to solutions of soluble salicylates.

Salicylic acid is more soluble in solutions of potassium or sodium citrate, acetate, phosphate, and nitrate than in water. A strong solution of potassium or sodium salicylate dissolves volatile oils, resins, phenol, creosote, menthol, camphor, and thymol. Sodium or potassium salicylate and other soluble salicylates gradually darken if they are even slightly alkaline. Salicylates give a violet to red color with ferric chloride, a green with copper salts, and a red or brown with nitrous acid.

Silver nitrate.—It may be oxidized to metallic silver with many organic substances. In solution, it is precipitated by the alkali hydroxides, carbonates, soluble chlorides, bromides, iodides, sodium phosphate, tannic acid, soluble citrates, and salicylates.

Silver Protein (Protargol).—It is precipitated by most metallic salts. It is decomposed by light and air. Cocaine hydrochloride causes a precipitate which may be prevented by the addition of boric acid.

Starch.—Iodine produces an intense blue color with either uncooked or cooked starch. Soluble starch is precipitated by alcohol if small amounts of inorganic salts are present.

Tannic Acid.—It produces a precipitate when added to solutions of gelatin, albumin, or starch. It gives a dark blue color with solutions of ferric salts. With pure ferrous salts, a white gelatinous precipitate is first produced, which turns blue through oxidation to ferric salts. Tannic acid precipitates most alkaloids and some glucosides. It also precipitates most metallic salts.

Terpin Hydrate.—It is somewhat soluble in water but more soluble in alcohol. It is decomposed by mineral acids.

Thiamine Hydrochloride.—The incompatibilities resemble those of the alkaloids. It is decomposed by alkali hydroxides.

Thymol.—It is slightly soluble in water and very soluble in alcohol, ether, oils, and alkalies.

Alkaline solutions turn dark on exposure to air and light. Thymol is precipiated from alkaline solution by iodine, forming thymol iodide. Oxidizing agents decompose it, forming colored compounds. It forms a liquid or soft mass when triturated with acetamide, acetanilid, aminopyrine, antipyrine, camphor, chloral hydrate, methol, phenol, salol, and urethane.

LATIN TERMS USED IN PRESCRIPTIONS

Term or phrase	Contraction	English meaning
Ad	ad	To, up to.
Adde, addantur	add	Add, let them be added.
Ad libitum	ad lib	At pleasure.
Aequales	aeq	Equal.
Agita	agit	Shake.
Albus	alb	White.
Alternis horis	alt. h	Every other hour.
Ana	$\overline{aa}$	Of each.
Ante	a	Before.
Ante cibos	a. c	Before meals.
Aqua	aq	Water.
Aqua aerata	aq. aerat	Carbonated water.
Aqua bulliens	aq. bull	Boiling water.
Bene	ben	Well.
Bis	b	Twice.
Bis in die	b. i. d	Twice a day.
Capiat	cap	Let the patient take.
Capsulae	caps., capsul	A capsule.
Capsulae amylaceae	caps. amyl	Amylaceous cachets.
Charta	chart	Paper, powder in a paper.
Charta cerata	chart. cerat	Waxed paper.
Chartula	chart	A small paper.
Cochleare amplum	coch. amp	A tablespoonful.
Cochleare magnum	coch. mag	A tablespoonful.
Cochleare medium	coch. med	A dessertspoonful.
Cochleare modicum	coch. mod	A dessertspoonful.
Cochleare parvum	coch. parv	A teaspoonful.
Collunarium	collun	A nose wash.
Collutorium	collut	A mouth wash.
Collyrium	collyr	An eye wash.
Coloretur	color	Let it be colored.
Continuantur remedia.	cont. rem	Let the medicine be continued.
Cum, centum	c	With, hundred.
Cyathus	cyath	A glassful.
Da	da	Give.
De	de	Of, from.
Dentur tales doses	d. t. d	Give such doses.
Detur	det	Let it be given.
Dexter	dexter	Right.
Diebus alternis	dieb. alt	Every other day.
Dies, dosis	d	A day, a dose.
Dispensa, Dispensetur	disp	Dispense.
Divide	div. dol	Divide.
Dolor	dol	Pain.
Dosis	dos	A dose.
Durante dolore	dur. dol	While the pain lasts.
Et	et	And.
Ex	e	Out of.
Ex aqua	ex aq	With water.
Ex modo prescripto	e. m. p	After the manner prescribed, as directed.
Fac, fiat, fiant	f., ft	Make.

LATIN TERMS USED IN PRESCRIPTIONS—Con.

Term or phrase	Contraction	English meaning
Flavius	flav	Yellow.
Gatgarisma	garg	A gargle.
Grossus	gros	Large, coarse.
Gutta, guttae	gtt	A drop.
Guttatim	guttat	Drop by drop.
Hora	h	Hour.
Hora decubitus	hor. dec	At bedtime.
Hora somni	hor. som	At bedtime.
Indies	ind	Daily.
Inter cibos	i. c	Between meals.
Jentaculum	jent	Breakfast.
Lac	lac	Milk.
Mane, minimum, misce.	m	Morning, a minim, mix.
Manus	manus	The hand.
Mitte	mitt	Send.
Mitte talis	mitt. tal	Send of such.
Mollis	moll	Soft.
More dictu	m. dict	As directed.
Nocte	noc	At night.
Non	non	Not.
Non repetatur	non rep	Do not repeat.
Numero	no	In number.
Octarius	o	A pint.
Oculi utrigue	o. u	Both eyes.
Ocula laevo	o. l	Left eye.
Oculus	ocul	The eye.
Oculus dexter	o. d	Right eye.
Oculus sinister	o. s	Left eye.
Omni hora	omn. hor	Every hour.
Omni mane	omn. man	Every morning.
Omnis	omn	Every.
Omni secunda hora	omn. sec. h	Every two hours.
Omni tertia hora	omn. tert. h	Every three hours.
Pabulum	pab	Food.
Partitis vicibus	part. vic	In divided doses.
Per	per	By means of.
Phiala prius agitata	p. p. a	Having first shaken the bottle.
Placebo	placebo	To please, satisfy.
Post cibos	p. c	After meals.
Pro re nata	p. r. n	As occasion arises, as needed.
Quantum satis, quantum sufficiat.	q. s	A sufficient quantity.
Quaque	q. q	Every.
Quinque	quinque	Five.
Recipe	Rx	Take (thou).
Repetatur	rept	Let it be repeated.
Secundum artem	s. a	According to art.
Semis	ss	Half.
Signa, signetur	s. sig	Label, let it be labeled.
Sine	s	Without.
Si opus sit	s. o. s	If needed.
Solve	solv	Dissolve.
Spiritus vini rectificatus.	s. v. r	Alcohol.
Spiritus vini tenuis	s. v. t	Proof spirit.
Statim	stat	Immediately.
Subtilis	subtil	Fine, smooth.
Sume, sumat, sumatur.	sum	Take, let it be taken.
Ter in die	t. i. d	Three times a day.
Ustus	ust	Burned.
Ut dictum	ut. dict	As directed.
Vel	v	Or.

Chapter IX

CHEMISTRY

Chemistry is the study of matter—its structure and change. It also considers the amounts and kinds of energy needed to make these changes, and the physical laws which govern them.

Matter

Matter is anything that occupies space and has mass (weight). In all ordinary changes, matter can neither be created nor destroyed. Recently, it has been shown that under certain extraordinary conditions, matter can be converted to energy.

Matter may exist in any of three states: gaseous. liquid, or solid.

Solids are rigid and retain their form.

Liquids flow and tend to assume the shape of the container in which they are placed.

Gases diffuse to fill completely the container in which they are placed. The particular state of matter at any given time usually depends on two conditions, namely its temperature and the pressure which is exerted on it.

For example, at ordinary temperatures and pressures, water is a liquid. But, if the temperature is increased beyond a certain point, the water changes to steam, a gas. On the other hand if the temperature is decreased, the water will change, at its freezing point, to the solid: ice.

Matter that is homogenous, such as water, iron, steel, salt, or air, is called a substance.

Properties—Identification of Matter

Properties are the characteristics of matter. They may be physical, such as color, odor, taste, solubility, melting point, boiling point, or chemical such as energy content, or the way a substance reacts when subjected to heat, light, electricity, or the action of some other substance. It is through the systematic study of these properties that the chemist is able to isolate, identify, and determine any given substance.

Classification of Matter

A pure substance can be placed in one of two classifications. It is either an element or a compound. An element is a substance that cannot be decomposed into two or more simpler substances by present, ordinary, chemical methods. For example; iron, oxygen, chlorine, mercury, carbon, lead, and the other elements listed in table III. A compound is a substance composed of two or more elements combined chemically in definite proportions by weight. The constituents of a compound can only be separated by chemical means, and do not retain their original properties. Take for example, water. It is composed of the two elements, hydrogen and oxygen. Both are gases. Hydrogen burns and oxygen supports combustion, yet, water, their common compound, is universally used to combat fire. Sodium and chlorine, two violently poisonous elements, combine to form salt, a compound that is absolutely essential to life.

The question now arises, suppose a substance is not pure? This matter then, is a mixture of elements or compounds or both which can be separated by other than chemical methods. A mixture may or may not be homogenous. Its components are not necessarily chemically combined nor combined in definite chemical proportions. The properties of the mixture, as a whole, are a composite of the individual properties of its components. For example, take a mixture of salt and water. It may be anything from wet salt to salty water (composition indefinite—individual properties retained). It may be separated simply by distilling the water from the mixture.

Classification of Elements

The elements have been carefully studied and it has been found that practically all of them can be made to react with oxygen to form compounds called oxides. If the oxide of a metal is placed in

water, the mixture will be basic, and if the oxide of a nonmetal is placed in water, the mixture will be acid. There are some elements whose oxides in water are either acid or basic. These elements are amphoteric. Those elements that cannot be made to react with oxygen are generally classed as nonmetals.

Table I.—CLASSIFICATION OF SOME OF THE ELEMENTS

Metals	Amphoteric elements	Nonmetals
Sodium.	Zinc.	Silicon.
Potassium.	Aluminum.	Oxygen.
Calcium.	Arsenic.	Carbon.
Iron.	Iodine.	Sulfur.
Mercury.		Chlorine.
Copper.		Neon.
Silver.		Helium.

Classification of Compounds

There are many systems used to classify compounds. However, all these systems follow the principle of grouping together compounds having like properties or origin. For example:

1. The acid-base system (in water):

Acids.—Compounds containing loosely bound hydrogen that can be replaced easily by a metal (e. g.—hydrochloric acid, sulfuric acid).

Bases.—Compounds that will react with acids to form *salts* and, generally, water (e. g.—lye, slaked lime, ammonia water).

Salts.—Compounds produced by the reaction of an acid with a base (e.g.—table salt: sodium chloride, or Epsom salts: magnesium sulfate).

2. By origin:

Organic.—Compounds that are derived from carbon.

Inorganic.—Compounds that are not derived from carbon.

Energy

Energy, a universal property of matter, is the ability to do work. Although matter may contain energy that is not available for work, the rest of the energy may be caused to express itself in any of a number of forms:

Potential energy.—Is the inherent energy of an object at rest. It is stored or available energy.

Kinetic energy.—Is the energy of motion or action. It may take the form of heat, light, electricity, motion or chemical reaction.

Like matter, in ordinary chemical changes, energy can neither be created nor destroyed. This is a statement of the "Law of Conservation of Energy".

Changes

Changes in matter are brought about by the action of energy. They are generally classed in two general groups: Physical changes are those which can be easily reversed and do not permanently alter the properties of matter (e. g.—the freezing of water). Whereas, in chemical changes, the substances undergoing the change, lose their original identity. When natural gas is burned, it forms water and carbon dioxide. Chemical changes are called "reactions."

Atomic Structure

The atom is the smallest particle of a chemical element to retain the properties of the element. Since this is the fundamental unit of any substance, we should examine it briefly to learn how and why it functions. In a series of brilliant experiments, many scientists, working independently, deduced the structure of the atom.

All atoms contain three types of particles called protons, neutrons and electrons.

The **proton** is the unit of positive electricity. That is, it has a charge of plus one. It has a mass of approximately one on the atomic weight scale. It is found concentrated in the nucleus (center) of the atom.

The **neutron** is a neutral particle bearing no electric charge. Its mass is approximately the same as that of the proton. It, too, is found in the nucleus. Notice that practically all the mass of an atom is concentrated in a very small part, the nucleus.

The **electron**, the unit of negative electricity, carries a charge of minus one; its mass is approximately 1/1838 of the mass of a proton. The electrons travel in definite circular paths, or orbits, about the nucleus, much in the same manner that the planets travel about the sun. In any free atom there are exactly as many "orbital" electrons as there are protons in the nucleus, the number of orbits depending on the total number of electrons.

Each orbit is saturated with electrons before the next is started. The orbit farthest from the nucleus may contain no more than eight electrons (except in the case of palladium). The following table gives the maximum number of electrons in any given orbit, and name of the orbit. They are listed in order of increasing distance from the nucleus.

Table II

Orbit No.	Orbit name	Maximum number of electrons	Orbit No.	Orbit name	Maximum number of electrons
1	K	2	5	O	32
2	L	8	6	P	18
3	M	18	7	Q	8
4	N	32			

The electrons in the outermost orbit are responsible for all the chemical properties of the element involved. Each element has a characteristic "atomic number" and "atomic weight." By the use of these two values it is possible to deduce the structure of any atom.

To illustrate, let us take an element whose atomic number is 6 and whose atomic weight is 12. The atomic number is equal to the number of protons in the nucleus. Therefore, an atom of this element has 6 protons (6+). Since the weight of an atom is equal to the protons plus the neutrons, the atom has a No. of neutrons=atomic weight−atomic number (12−6=6 neutrons).

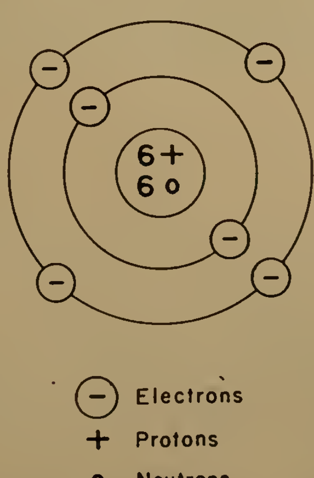


Figure 375.—Diagram of Atom of Carbon.

The number of electrons being equal to the number of protons means that the atom has six orbital electrons (6−). The structure is illustrated in Figure 375 and is an atom of carbon.

The atomic number and the atomic weight of any element (and generally the electron distribution) may be found in the "periodic chart" of the elements or in any of several tables devoted to that purpose.

Isotopes

All of the atoms of any given element have the same atomic number. This is what characterizes the atom as being a particular element. The atomic weight, on the other hand, may vary. Yet the chemical properties remain the same. The atoms whose atomic weights differ from that of the most common atoms are called isotopes. Normally an element exists as a mixture of the various natural isotopes. This accounts for the fractional atomic weights listed for the element as a whole.

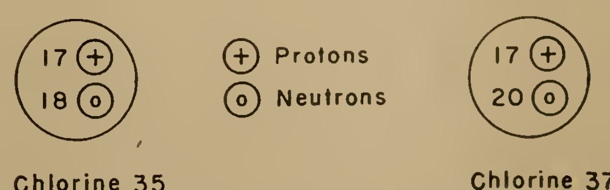


Figure 376.—Diagram of the Nuclei of the Chlorine Isotopes.

Thus chlorine exists as a mixture of 77 percent "chlorine 35" and 23 percent "chlorine 37," having atomic weights of 35 and 37, respectively. The atomic weight listed for natural chlorine is about 35.46 which represents the weighted average.

77 percent of 35	=26.95
23 percent of 37	= 8.51
100 percent of chlorine mixture	=35.46

The only way in which the weight of an atom can vary without changing the atomic number is to vary the number of neutrons in the nucleus. Therefore, the only difference between the isotopes of an element is the number of neutrons in the nucleus.

The istopes of an element, having like chemical properties, can only be separated by physical means such as diffusion.

SIMPLIFIED PERIODIC CH

METALS

NORMAL ELEMENTS

TRANSITIONAL ELEMENTS

	I A	II A	III B	IV B	V B	VI B	VII B	VIII B	
	2 1 · 3 Li 6.940	2 2 · 4 Be 9.013							
	2 8 1 · 11 Na 22.997	2 8 2 · 12 Mg 24.32							
	2 8 8 1 · 19 K 39.100	2 8 8 2 · 20 Ca 40.08	2 8 9 2 · 21 Sc 44.96	2 8 10 2 · 22 Ti 47.90	2 8 11 2 · 23 V 50.95	2 8 13 1 · 24 Cr 52.01	2 8 13 2 · 25 Mn 54.93	2 8 14 2 · 26 Fe 55.85	2 8 15 2 · 27 C 58.9
	2 8 18 8 1 · 37 Rb 85.48	2 8 18 8 2 · 38 Sr 87.63	2 8 18 9 2 · 39 Y 88.92	2 8 18 10 2 · 40 Zr 91.22	2 8 18 12 1 · 41 Cb (Nb) 92.91	2 8 18 13 1 · 42 Mo 95.95	2 8 18 13 2 · 43 Tc 99	2 8 18 15 1 · 44 Ru 101.7	2 8 18 16 1 · 45 Rh 102.9
	2 8 18 18 8 1 · 55 Cs 132.91	2 8 18 18 8 2 · 56 Ba 137.36	57-71 LANTHANIDE SERIES	2 8 18 32 10 2 · 72 Hf 178.6	2 8 18 32 11 2 · 73 Ta 180.88	2 8 18 32 12 2 · 74 W 183.92	2 8 18 32 13 2 · 75 Re 186.31	2 8 18 32 14 2 · 76 Os 190.2	2 8 18 32 17 · 77 Ir 193.
	2 8 18 32 18 8 1 · 87 Fr 223	2 8 18 32 18 8 2 · 88 Ra 226.05	89- ACTINIDE SERIES						

RARE EART

LANTHANIDE SERIES	2 8 18 18 9 2 · 57 La 138.92	2 8 18 19 9 2 · 58 Ce 140.13	2 8 18 20 9 2 · 59 Pr 140.92	2 8 18 22 8 2 · 60 Nd 144.27	2 8 18 23 8 2 · 61 Pm 147	2 8 18 24 8 2 · 62 Sm 150.43	2 8 18 25 8 2 · 63 Eu 152.

ACTINIDE SERIES	2 8 18 32 18 9 2 · 89 Ac 227	2 8 18 32 19 9 2 · 90 Th 232.12	2 8 18 32 20 9 2 · 91 Pa 231	2 8 18 32 21 9 2 · 92 U 238.07	2 8 18 32 22 9 2 · 93 Np 237	2 8 18 32 23 9 2 · 94 Pu 239	2 8 18 32 24 9 2 · 95 A 241

ART OF THE ELEMENTS

HYDROGEN

NONMETALS

INERT GASES

AMPHOTERIC

AMPHOTERIC

NORMAL ELEMENTS

Shells	VIII (cont.)	Shells	I B	Shells	II B	Shells	III A	Shells	IV A	Shells	V A	Shells	VI A	Shells	VII A	Shells	VIII A
1	1 H 1.0080															2	2 He 4.003
						2 3	5 B 10.82	2 4	6 C 12.010	2 5	7 N 14.008	2 6	8 O 16.000	2 7	9 F 19.00	2 8	10 Ne 20.183
						2 8 3	13 Al 26.98	2 8 4	14 Si 28.09	2 8 5	15 P 30.975	2 8 6	16 S 32.066	2 8 7	17 Cl 35.547	2 8 8	18 A 39.944
2 8 16 2	28 Ni 58.69	2 8 18 1	29 Cu 63.54	2 8 18 2	30 Zn 65.38	2 8 18 3	31 Ga 69.72	2 8 18 4	32 Ge 72.60	2 8 18 5	33 As 74.91	2 8 18 6	34 Se 78.96	2 8 18 7	35 Br 79.916	2 8 18 8	36 Kr 83.80
2 8 18 18	46 Pd 106.7	2 8 18 18 1	47 Ag 107.88	2 8 18 18 2	48 Cd 112.41	2 8 18 18 3	49 In 114.76	2 8 18 18 4	50 Sn 118.70	2 8 18 18 5	51 Sb 121.76	2 8 18 18 6	52 Te 127.61	2 8 18 18 7	53 I 126.91	2 8 18 18 8	54 Xe 131.3
2 8 18 32 17 1	78 Pt 195.23	2 8 18 32 18 1	79 Au 197.2	2 8 18 32 18 2	80 Hg 200.61	2 8 18 32 18 3	81 Tl 204.39	2 8 18 32 18 4	82 Pb 207.21	2 8 18 32 18 5	83 Bi 209.00	2 8 18 32 18 6	84 Po 210	2 8 18 32 18 7	85 At 210	2 8 18 32 18 8	86 Rn 222

ELEMENTS

Shells		Shells		Shells		Shells		Shells		Shells		Shells		Shells	
2 8 18 25 9 2	64 Gd 156.9	2 8 18 26 9 2	65 Tb 159.2	2 8 18 28 8 2	66 Dy 162.46	2 8 18 29 8 2	67 Ho 164.94	2 8 18 30 8 2	68 Er 167.2	2 8 18 31 8 2	69 Tm 169.4	2 8 18 32 8 2	70 Yb 173.04	2 8 18 32 9 2	71 Lu 174.99
2 8 18 32 25 9 2	96 Cm 242	2 8 18 32 26 9 2	97 Bk 243	2 8 18 32 27 9 2	98 Cf 244		99		100		101		102		103

The Periodic Chart of the Elements

Careful study has shown that the properties of the elements vary as a periodic function of their atomic numbers. This means that when the properties of the elements are listed in the order of increasing atomic number, that every so often an element occurs whose properties are similar to those of a previous element. From these observations, it was found that if each period, or series, were placed below the previous period that the elements of similar properties would fall in columns, while at the same time preserving the original order in which they were placed.

This chart serves as a condensed and easily-referred-to index of the properties of the chemical elements. It is reproduced on page 492 in a simplified form.

The following information is readily obtained from this periodic chart:

1. The atomic number.
2. The atomic weight.
3. The distribution of electrons in the orbits.
4. The chemical symbols of the elements.
5. The chemical properties of the elements.

KEY TO THE PERIODIC CHART OF THE ELEMENTS

Electron Distribution by Orbits		GROUP NO.
	K	
	L	Atomic Number
	M	
	N	Symbol
	O	
	P	Atomic Weight
	Q	

Since the properties of the elements within the same group (column) are similar, the properties of an element are easily derived from its position on the periodic chart.

Table III.—TABLE OF ATOMIC WEIGHTS LISTED ALPHABETICALLY BY NAMES OF ELEMENTS

Element	Symbol	Atomic No.	Atomic weight [1]
Actinium	Ac	89	227
Aluminum	Al	13	26. 98
Americium	Am	95	(241)
Antimony	Sb	51	121. 76
Argon	A	18	39. 944
Arsenic	As	33	74. 91
Astatine	At	85	(210)
Barium	Ba	56	137. 36
Berkelium	Bk	97	(243)
Beryllium	Be	4	9. 013
Bismuth	Bi	83	209. 00
Boron	B	5	10. 82
Bromine	Br	35	79. 916
Cadmium	Cd	48	112. 41
Calcium	Ca	20	40. 08
Californium	Cf	98	(244)
Carbon	C	6	12. 010
Cerium	Ce	58	140. 13
Cesium	Cs	55	132. 91
Chlorine	Cl	17	35. 547
Chromium	Cr	24	52. 01
Cobalt	Co	27	58. 94
Copper	Cu	29	63. 54
Curium	Cm	96	(242)
Dysprosium	Dy	66	162. 46
Erbium	Er	68	167. 2
Europium	Eu	63	152. 0
Fluorine	F	9	19. 00
Francium	Fr	87	(223)
Gadolinium	Gd	64	156. 9
Gallium	Ga	31	69. 72
Germanium	Ge	32	72. 60
Gold	Au	79	197. 2
Hafnium	Hf	72	178. 6
Helium	He	2	4. 003
Holmium	Ho	67	164. 94
Hydrogen	H	1	1. 0080
Indium	In	49	114. 76
Iodine	I	53	126. 91
Iridium	Ir	77	193. 1
Iron	Fe	26	55. 85
Krypton	Kr	36	83. 80
Lanthanum	La	57	138. 92
Lead	Pb	82	207. 21
Lithium	Li	3	6. 940
Lutetium	Lu	71	174. 99
Magnesium	Mg	12	24. 32
Manganese	Mn	25	54. 93
Mercury	Hg	80	200. 61
Molybdenum	Mo	42	95. 95
Neodymium	Nd	60	144. 27
Neon	Ne	10	20. 183
Neptunium	Np	93	(237)
Nickel	Ni	28	58. 69
Niobium (Columbium)	Nb(Cb)	41	92. 91
Nitrogen	N	7	14. 008
Osmium	Os	76	190. 2
Oxygen	O	8	16. 0000
Palladium	Pd	46	106. 7
Phosphorus	P	15	30. 975
Platinum	Pt	78	195. 23
Plutonium	Pu	94	(239)
Polonium	Po	84	210

[1] A value given in parentheses denotes the mass number of the most stable known isotope.

Table III.—TABLE OF ATOMIC WEIGHTS LISTED ALPHABETICALLY BY NAMES OF ELEMENTS—Continued

Element	Symbol	Atomic No.	Atomic weight [1]
Potassium	K	19	39. 100
Praseodymium	Pr	59	140. 92
Promethium	Pm	61	(147)
Protactinium	Pa	91	231
Radium	Ra	88	226. 05
Radon	Rn	86	222
Rhenium	Re	75	186. 31
Rhodium	Rh	45	102. 91
Rubidium	Rb	37	85. 48
Ruthenium	Ru	44	101. 7
Samarium	Sm	62	150. 43
Scandium	Sc	21	44. 96
Selenium	Se	34	78. 96
Silicon	Si	14	28. 09
Silver	Ag	47	107. 880
Sodium	Na	11	22. 997
Strontium	Sr	38	87. 63
Sulfur	S	16	32. 066
Tantalum	Ta	73	180. 88
Technetium	Tc	43	(99)
Tellurium	Te	52	127. 61
Terbium	Tb	65	159. 2
Thallium	Tl	81	204. 39
Thorium	Th	90	232. 12
Thulium	Tm	69	169. 4
Tin	Sn	50	118. 70
Titanium	Ti	22	47. 90
Tungsten (Wolfram)	W	74	183. 92
Uranium	U	92	238. 07
Vanadium	V	23	50. 95
Xenon	Xe	54	131. 3
Ytterbium	Yb	70	173. 04
Yttrium	Y	39	88. 92
Zinc	Zn	30	65. 38
Zirconium	Zr	40	91. 22

[1] A value given in parentheses denotes the mass number of the most stable known isotope.

Valence

The valence of an element is defined as the number of atoms of hydrogen or chlorine that one atom of the element will hold or displace. The valence of an element shows how it will combine with other elements to form compounds. It is entirely due to the number of electrons in the outermost, or valence, orbit.

The most stable condition of an atom is when the valence orbit is saturated with electrons. That is, with eight electrons unless the outermost orbit is the "K" orbit then two electrons saturate the orbit.

Example.—Helium and Neon are completely chemically-inert. That is, having saturated outer orbits, they do not enter into chemical reactions. In order to achieve this stability, the atoms, other

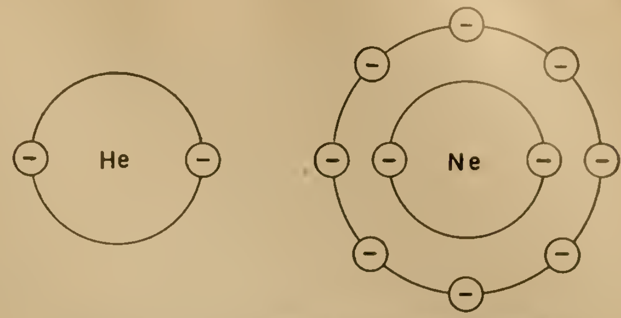


Figure 377.—Diagram of An Atom of Helium and Neon.

than the inert gases, will either give up, accept, lend, borrow, or share their valence electrons. For example.—

The alkali metals (group IA) have one valence electron. The halogens (group VIIA) have seven valence electrons. Therefore, if an atom alkali metal gives its valence electron to an atom of halogen, the condition for stability is satisfied for both particles. But this leaves a positive charge on the alkali metal (more protons than electrons) and a negative charge on the halogen (more electrons than protons).

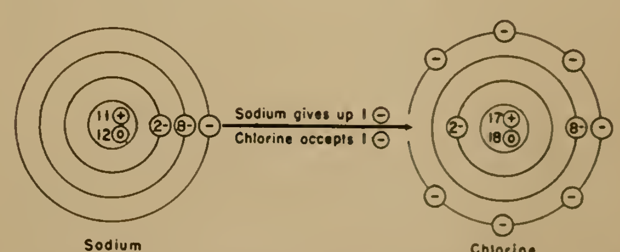


Figure 378.—The Reaction of an Atom of Sodium and an Atom of Chlorine.

Since opposites attract, and since each particle carries a charge of one, one atom of the alkali metal pairs off with one atom of halogen.

The valence of the alkali metals (group IA) is plus one (each will hold only one atom of chlorine). And, the valence of the halogens (group VIIA) is a minus one.

By the same type of experimental reasoning it can be shown that the valence of the alkaline earth metals (group IIA) is plus two, since these have two valence electrons.

The following table gives the normal (most usual) valence of the normal elements (see periodic chart), and, also, whether the valence electrons are given or accepted.

Table IV

Number of group valence electrons	Valence	Number of electrons given or accepted
IA—1	+1	1 given.
IIA—2	+2	2 given.
IIIA—3	+3	3 given.
IVA—4	±4	4 given or accepted.
VA—5	−3	3 accepted.
VIA—6	−2	2 accepted.
VIIA—7	−1	1 accepted.
VIIIA—8	0	None given or accepted.

The transitional elements usually have 2 or more valence states, since the orbit next to the valence orbit will contribute electrons to the valence of the element.

For example.—Mercury has two valence states: Plus 1 (called mercurous) and plus 2 (called mercuric).

Table V.—COMMON VALENCE NUMBERS

	Monovalent		Divalent		Trivalent	
Metals	Sodium	Na^{+}	Calcium	Ca^{++}	Aluminum	Al^{+++}
	Potassium	K^{+}	Copper (ic)	Cu^{++}	Iron (ferric)	Fe^{+++}
	Ammonium	NH_4^{+}	Magnesium	Mg^{++}	Chromium	Cr^{+++}
	Silver	Ag^{+}	Mercuric	Hg^{++}	Arsenic	As^{+++}
	Mercurous	Hg^{+} or Hg_2^{++}	Iron (ferrous)	Fe^{++}	Antimony	Sb^{+++}
			Lead	Pb^{++}		
			Zinc	Zn^{++}		
Nonmetals	Chlorine	Cl^{-}	Oxygen	O^{--}	Nitrogen	N^{---}
	Bromine	Br^{-}	Sulfur	S^{--}	Phosphorus	P^{---}
	Iodine	I^{-}				
	Fluorine	F^{-}				
Radicals	Hydroxide	OH^{-}	Carbonate	CO_3^{--}	Phosphate	PO_4^{---}
	Nitrate	NO_3^{-}	Sulfate	SO_4^{--}	Arsenate	AsO_4^{---}
	Chlorate	ClO_3^{-}	Sulfite	SO_3^{--}		
	Bicarbonate	HCO_3^{-}				

Symbols

In the same convenient way that mathematics uses a system of symbols: 1, 2, 3, for the numbers one, two, three, etc., chemistry has developed around the use of symbols for the chemical elements. Without the use of symbols, written chemistry would be cumbersome and tedious.

The symbol for a chemical element is usually the first letter in the name of that element. To avoid confusion another key letter in the name is also used. Usually this is the second letter.

For example, since C is the symbol for carbon, the symbol Co was assigned to cobalt, in order that the two might not become confused.

Many of the elements were discovered in the days when Latin was the language of science. Their symbols were therefore derived from their Latin names. For example: Natrium was the Latin name for sodium. Thence the symbol Na. Plumbum was the name for lead. Therefore, the symbol Pb was assigned. Ferrum, the Latin for iron, gives rise to the symbol Fe. Tungsten, symbol W, has become the official name for the element that was called Wolfram.

Formula

Since compounds are formed of elements the composition of a compound may be expressed by grouping together the symbols of its component elements. For example: table salt is composed from sodium and chlorine in an atom for atom ratio. The formula is then simply NaCl. The formula for quick lime, calcium oxide, is CaO.

When there is more than one atom of a particular element in a single molecule of a compound, a number is placed at the lower right of the symbol, designating the number of atoms of that element in each molecule. For example, H_2SO_4 is the formula for sulfuric acid. The formula tells us that each molecule of sulfuric acid contains 2 atoms of hydrogen, 1 atom of sulfur, and 4 atoms of oxygen. H_2O indicates that in each molecule of water there are 2 atoms of hydrogen and 1 atom of oxygen. Sugar has the formula $C_{12}H_{22}O_{11}$.

The usual formula for inorganic compounds expresses the simplest ratio of elements in the compound. This is called the empirical formula.

Sometimes the simplest formula does not give a true picture of the molecule. Then it is necessary to modify the formula to fit the situation. This is usually done by using a "molecular" formula. This formula expresses the actual numbers of atoms that occur in the molecule. For example, calomel, or mercurous chloride, has the empirical formula HgCl. However, each molecule contains two atoms of mercury and two atoms of chlorine. Therefore, the molecular formula becomes Hg_2Cl_2. (Other examples: Hydrogen, H_2; Oxygen, O_2; Chlorine, Cl_2; Iodine, I_2; Nitrogen, N_2; Phosphorus, P_4.)

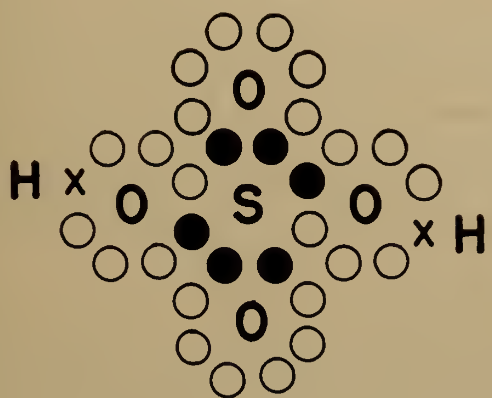
Radicals

When certain compounds, such as sulfuric acid (H_2SO_4) and potassium cyanide (K(CN)), undergo chemical changes, some of their atoms remain grouped together. These groups, called radicals, are more or less resistant to change.

Since radicals tend to retain their characteristics and are generally removed from their compounds as a unit, it is convenient to write them as a unit in writing formulas. This is done by including the radicals in parentheses (e. g.)

Calcium hydroxide	$Ca(OH)_2$ instead of CaO_2H_2
Aluminum sulfate	$Al_2(SO_4)_3$ instead of $Al_2S_3O_{12}$
Ammonium sulfide	$(NH_4)_2S$ instead of N_2H_8S
Potassium ferrocyanide	$K_4(Fe(CN)_6)$ instead of $K_4FeC_6N_6$

The subscript number indicates the number of times the radical occurs in one molecule of the substance. In any compound the valences of all the atoms must be satisfied; therefore, it is sometimes necessary to use the "electronic" formula. This type of formula very nearly shows the actual structure of the molecule (e. g.)



○ = The valence electrons of oxygen

X = The valence electrons of hydrogen

● = The valence electrons of sulfur

Figure 379.—The Electronic Structure of Sulfuric Acid.

Molecular Weights

Since each element has a definite atomic weight, and a formula shows the number and kind of atoms present, it follows that the "molecular" or formula weight can be deduced from the formula; e. g., sodium bicarbonate has the formula $NaHCO_3$.

Element	*Atomic weight*		*Number of atoms*		*Weight of element in compound*
Na	22. 997	×	1	=	22. 997
H	1. 008	×	1	=	1. 008
C	12. 010	×	1	=	12. 010
O	16. 000	×	3	=	48. 000
Molecular weight of $NaHCO_3$				=	84. 015

Equations

By the use of formulas it is possible to indicate precisely what happens in a chemical reaction. What happens when sodium hydroxide, lye, ($NaOH$) is added to hydrochloric acid (HCl)? Water (H_2O) and Salt ($NaCl$) are formed chemically.

$$Na(OH)+HCl \rightarrow H(OH)+NaCl$$

This is called an equation.

Notice that the number of atoms of each element to the left of the arrow is equal to the number of atoms of the same element to the right of the arrow. This is essential!! If one molecule of a substance reacts with other than one molecule of another substance, it is necessary to adjust this by "balancing the equation." This is done by placing a small whole number in front of each formula, indicating the relative number of molecules involved.

Examples:

$$2H_2+O_2 \rightarrow 2H_2O$$
$$Ca(OH)_2+2HCl \rightarrow CaCl_2+2H_2O$$
$$2Al+3H_2SO_4 \rightarrow Al_2(SO_4)_3+3H_2$$
$$Fe_2O_3+3H_2 \rightarrow 2Fe+3H_2O$$

In most cases, if the formulas are known, the equation may be balanced quickly by trial and error. With a little practice, you should have no difficulty in balancing equations.

In a balanced equation the sum of the weights of all the substances on one side of the arrow is equal to the sum of the weight of all the substances on the other side.

$$Ca(OH)_2+2HCl = CaCl_2+2H_2O$$
$$(74.096)+(2\times 36.465) = 110.994+(2\times 18.016)$$
$$(72.930) \qquad (36.032)$$
$$147.026 = 147.026$$

Acids, Bases, Salts

Acids are compounds of hydrogen. When they are in water solution, they will change the color of litmus from blue to red. They have a sour taste. The hydrogen of an acid is easily replaced by an active metal such as zinc.

Many compounds of hydrogen are not acids. In these compounds, the hydrogen is more tightly bound; e. g., NH_3, $NaOH$, CH_4. Acids may be

classified according to the number of hydrogen "ions" (protons) furnished by each molecule.

Monobasic, 1 proton
Dibasic, 2 protons
Tribasic, 3 protons

Table VI.—SOME COMMON ACIDS CLASSIFIED

Monobasic	Dibasic	Tribasic
HCl (hydrochloric acid).	H_2SO_4 (sulfuric acid).	H_3PO_4 (phosphoric acid).
HBr (hydrobromic acid). HNO_2 (nitrous acid). HNO_3 (nitric acid). $H(C_2H_3O_2)$ (acetic acid).	H_2CO_3 (carbonic acid).	H_3BO_3 (boric acid).

Bases are compounds which will react with acids to form salts. In water solution they turn red litmus blue. They have a bitter taste and a soapy feel. Ordinarily, they contain the hydroxyl radical (OH) attached to a metal which is readily replaced. According to modern concepts, a base is any substance which will accept a proton. They can be classified according to the number of protons they will accept. That is, monoacid, diacid, and triacid, depending upon whether they accept one, two, or three protons respectively.

Table VII.—SOME COMMON BASES CLASSIFIED

Monoacid	Diacid	Triacid
KOH (potassium hydroxide). NaOH (sodium hydroxide). NH_4OH (ammonium hydroxide).	$Ca(OH)_2$ (calcium hydroxide). $Mg(OH)_2$ (magnesium hydroxide).	$Al(OH)_3$ (aluminum hydroxide).

The classes of acids and bases are more readily understood when the student considers that one molecule of a diacid base will react with two molecules of a monobasic acid. ($Ca(OH)_2+2HCl \rightarrow CaCl_2+H_2O$), or that one molecule of a tribasic acid will combine with three molecules of a monoacid base ($H_3PO_4+3NaOH \rightarrow Na_3PO_4+3H_2O$).

Relations between acids and bases.—In some acids the protons are more readily given up than in others. The strength of an acid depends on the ease with which this occurs. A strong acid gives up its protons readily. A weak acid does so with difficulty. Conversely, a strong base readily accepts a proton while a weak base does not.

Table VIII.—RELATIVE STRENGTH OF SOME COMMON ACIDS AND BASES

Bases		Acids
NaOH KOH	Strong	HCl. H_2SO_4. HNO_3.
$Ca(OH)_2$ $Mg(OH)_2$	Moderate	H_3PO_4. HNO_2.
NH_4OH $Zn(OH)_2$	Weak	HCN. $H(C_2H_3O_2)$.
H_2O NaCl	Neutral	H_2O. NaCl.

Salts are the products of the reaction of an acid and a base. They generally contain a metal, or the ammonium radical, and an acid radical, such as

NH_4—	$>PO_4$	—Cl	or $>SO_4$
Ammonium	Phosphate	Chloride	Sulfate

They are classified according to their composition. Normal salts contain neither replaceable hydrogens nor replaceable hydroxyl groups. *Example.*—NaCl, K_2SO_4. Acid salts contain a replaceable hydrogen. *Examples.*—$NaHCO_3$, Na_2HPO_4. Basic salts contain a replaceable hydroxyl. *Examples.*—$Ca(OH)Cl$, $Bi(OH)NO_3$.

Nomenclature

The naming of compounds follows a definite system. Since compounds are composed of elements, which may be in the form of radicals, the system revolves around the naming of the various parts of the compounds. Drawing an arbitrary line, we can separate these parts into two classes—metallic and nonmetallic. The metallic is named first and the nonmetallic is named second.

The metallic portion is generally an elemental metal. The only common exception is the ammonium (NH_4) radical. If only one valence state exists, the metallic portion receives the name of the metal. (Sodium ———; Calcium ———; Magnesium ———.) When more than one valence state exists, compounds of the lower valence state are designated by the ending "ous" on the name of the metal. The ending "ic" is used to indicate the higher of the valence states.

Element	Lower valence	Higher valence
Iron	Ferrous hydroxide $Fe(OH)_2$	Ferric hydroxide $Fe(OH)_3$.
Mercury	Mercurous chloride Hg_2Cl_2.	Mercuric chloride $HgCl_2$.
Tin	Stannous chloride $SnCl_2$	Stannic chloride $SnCl_4$.

The nonmetallic portion of the molecule is generally named according to the acid from which it is derived. Acids are divided into binary and ternary acids, depending on whether they have two or three different elements. Binary acids are named by using the prefix "hydro" plus the ending, "ic." For example.—hydro chlor ic is the name of the binary acid of chlorine (HCl). The name of the binary acid of sulfur (H_2S) would then be hydro sulfur ic. The ternary acids are named according to the amount of oxygen they contain. If the acid contains as much oxygen as it normally can, it is named with the ending "ic." If the acid contains one less atom of oxygen than the normal, the name receives the ending "ous." If it contains two less atoms of oxygen than normal, the prefix "hypo" is used in addition to the ending "ous." When there is one oxygen more than normal, the prefix "per" is used in addition to the ending "ic."

The following table illustrates the naming of the acids (and salts):

Table IX

Formula of acid	Name of acid	Formula of corresponding sodium salt	Name of salt
Binary acids			
HCl	Hydro chlor ic	$NaCl$	Sodium chlor ide.
HBr	Hydro brom ic	$NaBr$	Sodium brom ide.
H_2S	Hydro sulfur ic	Na_2S	Sodium sulf ide.
Ternary acids			
$HClO$	Hypo chlor ous	$NaClO$	Sodium hypo chlor ite.
$HClO_2$	— Chlor ous	$NaClO_2$	Sodium — chlor ite.
$HClO_3$	— Chlor ic	$NaClO_2$	Sodium — chlor ate.
$HClO_4$	Per chlor ic	$NaClO_4$	Sodium per chlor ate.
H_2SO_4	Sulfur ic (common)	Na_2SO_4	Sodium sulf ate.
H_2SO_3	Sulfur ous	Na_2SO_3	Sodium sulf ite.
$H_2S_2O_7$	Per sulfur ic	$Na_2S_2O_7$	Sodium per sulf ate.
$H_2N_2O_2$	Hypo nitr ous	$Na_2N_2O_2$	Sodium hypo nitr ite.
HNO_2	Nitr ous	$NaNO_2$	Sodium nitr ite.
HNO_3	Nitr ic (common)	$NaNO_3$	Sodium nitr ate.

The salts are then named from the acids by substituting "ite" endings for the "ous" in the name of the ternary acid and "ate" for the "ic" in ternary acids.

The "ic" ending in binary acids is substituted by "ide" in the naming of their salts.

In compounds such as mixed salts, double salts, and complex compounds, each of the elements and radicals is named. The metallic constituents first and the nonmetallic last. For example:

$NaK(SO_4)$	Sodium potassium sulfate.
$Mg(NH_4)(PO_4)$	Magnesium ammonium phosphate.
$KAl(SO_4)_2$	Potassium aluminum sulfate.
$NaH(SO_3)$	Sodium hydrogen sulfite or sodium acid sulfite.
$Ca(OH)Cl$	Calcium hydroxy chloride or calcium basic chloride.
K_2HgI_4	Potassium mercuric iodide.
$K_4(Fe(CN)_6)$	Potassium ferro cyanide.

In the case of acid salts, the designation "bi" or "acid" is commonly used. For example:

$NaHCO_3$	Sodium bicarbonate or sodium acid carbonate.
$NaH(SO_3)$	Sodium bisulfite or sodium acid sulfite.

Some compounds are neither acids, bases, nor salts. By and large, these are binary compounds and are named according to the system for the salts of binary acids; e. g., calcium oxide (CaO): magnesium nitride (Mg_3N_2); calcium carbide (CaC_2).

Reactions

Chemical reactions are divided into four general classes.

1. **Combination reactions** occur when two substances combine to form one substance.

$$C + O_2 = CO_2$$

2. **Displacement reactions.**—In these, one element displaces another element from a compound.

$$Zn + H_2SO_4 = H_2 + ZnSO_4$$

3. **Decomposition reactions** are characterized by the decomposition of one substance to form two or more substances.

$$CaCO_3 + \text{heat} = CaO + CO_2$$

4. **Double decomposition reactions** are, by far, the most commonly encountered chemical reactions. They involve the inter-action of two or more substances to form two or more new substances. This class may be subdivided into many subgroups. The three most common are:

The **acid-base system** in which an acid reacts with a base to give salt and water. This system as it occurs in blood is essential to life.

$$NaOH + HCl = NaCl + H_2O$$

The **precipitation reactions** in which two soluble substances react to form one or more insoluble

products. Usually, the insoluble products in the reaction are indicated with an arrow pointing downward. This is the system involved in the formation of kidney stones.

$$BaCl_2+Na_2SO_4=BaSO_4\downarrow+2NaCl$$
$$H_2S+CuSO_4=CuS\downarrow+H_2SO_4$$

The oxidation-reduction system.—These reactions make possible the conversion of food to energy in the body. It is perhaps a little more complex than the other types of reactions. This is because it involves a change in valence state. Oxidation and reduction always occur simultaneously. In other words, when one substance is oxidized, another is reduced. An increase in the valence state of an atom shows this atom to have been oxidized.

Relation of various oxidation states of sulfur.

Compound:	SO_3	SO_2	S	H_2S
Valence State:	S^{6+}	S^{4+}	S^0	$S^{=}$

Oxidation $\longleftarrow$

Reduction $\longrightarrow$

Conversely, a decrease in valence number indicates reduction.

1.

iron oxidized

$$\underset{Fe^{++}}{2FeCl_2}+\underset{0}{\overset{Cl^0}{Cl_2}}=\underset{Fe^{+++}}{\overset{Cl^-}{2FeCl_3}}$$

chlorine reduced

2.

manganese reduced

$$\underset{Mn^{7+}}{2KMnO_4}+\underset{1-}{\overset{Cl^-}{10HCl}}+3H_2SO_4\longrightarrow K_2SO_4+\underset{Mn^{++}}{2MnSO_4}+\underset{0}{5Cl_2}+8H_2O$$

chlorine oxidized

In the above reactions the valence of chlorine changes from minus one to zero, an increase. Therefore, chlorine is oxidized. The valence of manganese changes from plus seven to plus two, a decrease. Therefore, manganese, the substance reduced, is the oxidizing agent.

Percentage composition.—The percent of an element in a compound can be calculated from the formula of the compound.

The percentage composition of a substance can be obtained as follows: (1) Find the molecular weight of the substance; (2) divide the atomic weight of each element (or its multiple) by the molecular weight; (3) multiply each quotient by 100 to give the percentage.

Problem: Find the percentage composition of Na_2HPO_4.

Solution: $\underset{(2\times23)}{2\,Na}+\underset{1}{H}+\underset{31}{P}+\underset{64}{4(4\times16)O}=142$

$$\text{Percent Na}=\frac{2\times23}{142}\times100\cong32.4\text{ percent}$$
$$\text{Percent H}=\frac{1}{142}\times100\cong0.71\text{ percent}$$
$$\text{Percent P}=\frac{31}{142}\times100\cong21.82\text{ percent}$$
$$\text{Percent O}=\frac{4\times16}{142}\times100\cong45.07\text{ percent}$$
$$\text{Total}=100.00\text{ percent}$$

It follows, then, that if the weight of a compound is known, the weight of any of the elements it contains may be readily calculated.

Problem.—Find the number of grams of sodium in 30 grams of sodium chloride.

$$\frac{Na}{NaCl}=\frac{22.997}{58.454}=0.3934\times100=39.34\text{ percent}$$

Sodium chloride contains 39.34 percent sodium: 39.34 percent of 30 grams = 11.802 grams of sodium in 30 grams of sodium chloride.

Since in a chemical reaction the law of conservation of mass is implied, it is possible to calculate the weights of the substances involved. For example.—It is possible to calculate the weight of silver chloride which can be produced from a known weight of sodium chloride and vice versa.

Problem.—How many grams of silver chloride can be produced from 29.3 grams of sodium chloride according to the following reaction?

Measured weights 29.3 X

$$NaCl+AgNO_3\rightarrow AgCl\downarrow+NaNO_3$$

143.4

Formula weights 58.5

This problem is solved by ratio and proportion, according to the general rule that the ratios of the weights of the substances to the molecular weights of the substances are proportional.

$$\frac{29.3}{58.5}=\frac{X}{143.4}$$

where

X = weight of silver chloride produced.
29.3 = weight of NaCl.
58.5 = molecular weight of NaCl.
143.1 = molecular weight of AgCl.

Solving for X

$$X=\frac{29.3\times 143.4}{58.5}=\frac{4201.62}{58.5}=71.8 \text{ grams}$$

The steps to follow in the solution of a problem of this type are:

1. Write the balanced equation for the reaction involved.
2. Calculate the molecular weights of the substances involved. Write the molecular weights under the corresponding formulas.
3. Multiply the molecular weight by the number of times the substance occurs (e.g., $2NaCl=2\times 58.5=117.0$).
4. Write the measured weight of the known substance above its formula.
5. Place an X above the formula of the substance whose weight is to be found.
6. Set up the ratio and proportion. Solve for X.

Problem.—How many grams of HCL are necessary to make 100 grams of calcium chloride from calcium carbonate?

$$CaCO_3+\underset{2\times 36.5}{\overset{X}{2HCl}}\longrightarrow \underset{111}{\overset{100g.}{CaCl_2}}+H_2O+CO_2$$

$$2\times\frac{X}{36.5}=\frac{100}{111}\text{ OR }\frac{X}{73.0}\ \frac{100}{111}$$

$$X=65.77 \text{ grams of HCl}$$

Study the section on solutions and concentration before attempting these calculations.

In dealing with solutions, a solution with an even concentration is seldom encountered. To calculate molarities, it is necessary to know first the number of moles in one liter of solution. The number of moles of any substance is equal to the weight of the substance divided by the molecular weight.

$$\frac{\text{weight}}{\text{molecular weight}}=\text{moles (number of gram molecular weights)}$$

Example.—500 cc. of a solution contains 30 grams of HCl. What is the concentration expressed as molarity?

$$\frac{500}{30}=\frac{1,000}{X}$$

X = 60 grams of HCl in one liter of solution

$$\frac{60}{36.5}=\text{moles per liter of solution}$$

This solution is, then, 1.642 M HCl.

Normalities of solutions are calculated in exactly the same fashion except that the gram equivalent weight is used wherever the gram molecular weight is used in solving for molarities.

Example.—How many grams of H_2SO_4 are necessary to form a liter of 1.5N H_2SO_4?

$$\frac{\text{weight}}{\text{equivalent weight}}=\text{number of chemical equivalents}$$

equivalent weight of H_2SO_4

$$=\frac{\text{molecular weight of } H_2SO_4}{2}=\frac{98}{2}=49$$

$$\frac{X}{49}=1.5$$

$$X=1.5\times 49$$

$$X=73.5 \text{ grams } H_2SO_4$$

Solutions

Solutions are homogenous mixtures of substances. All solutions consist of two parts: The solvent or substance in which another substance dissolves, and the solute or substance which dissolves in the solvent. Usually the constituent present in the greatest proportion is called the solvent. In a true solution, the particles of the solute are of molecular size.

There are three types of solutions, classified according to their physical state:

1. **Gaseous solutions.**—Gases mix with one another in all proportions to form homogenous mixtures, which may be called solutions.

Example.—Dry air is a solution containing about 78 percent nitrogen and 21 percent oxygen, the other 1 percent consisting of carbon dioxide, and the rare gases, helium, neon, argon, etc.

2. **Liquid solutions.**—Gases, liquids, and solids dissolved in liquid solvents are called liquid solutions.

Examples.—Pure HCl is a gas which dissolves readily in water to form an aqueous solution of hydrochloric acid. Oils form liquid solutions in chloroform. Salts, sugars, and bases dissolved in water are also liquid solutions.

3. **Solid solutions.**—In these solutions, gases, liquids and solids are dissolved in solids.

Example.—Hydrogen dissolves in solid palladium. Certain alloys are solid solutions of one metal in another.

Electrolytes and nonelectrolytes, and ionization

Solutes may be classified according to whether their water solutions will conduct electricity. Acids, bases, and salts are called electrolytes because their solutions conduct electricity. The reason they do is that they separate into electrically charged particles called ions when they are dissolved by water.

$$\text{NaCl in water} \rightarrow Na^{+} + Cl^{-}$$

It is the ions, moving freely in the solution, that allow the electricity to flow.

This phenomenon was called ionization. Actually a more proper term is "the dissociation of ionic compounds." According to modern theories (the Debye-Hückle Theory), electrolytes are completely ionized in the pure state, but the oppositely charged ions are held in close association by their electrostatic charges. The solution of ionic compounds (electrolytes) in water merely allows the ions a greater degree of freedom.

$$\underset{\text{Ions close together}}{\text{(Solid) } Na^{+}Cl^{-}} \textit{ in water solution} \rightarrow \underset{\text{Ions separated}}{Na^{+} + Cl^{-}}$$

Solubility (the degree to which a solute will dissolve in a given solvent).—It is a commonly observed fact that some substances will dissolve in one solvent but will fail to dissolve in another while others will dissolve in the second solvent but not in the first. Also, that the solubility of a solute in a given solvent varies with the physical conditions imposed on the system. These problems have been carefully studied from the beginning of chemical science and many of the knots have been unravelled, but the final answers have not yet been found. Some useful rules, however, have been developed.

Compounds of similar composition tend to be mutually soluble. For example.—Acids, bases and salts are ionically bound and are more or less soluble in water which is also of a polar (ionic) character. These compounds are not particularly soluble in gasoline, which is not a polar compound. On the other hand, fats and oils, which are nonpolar, are not soluble in water but are soluble in gasoline.

Compounds which react chemically with one another tend to be mutually soluble. This is shown by the fact that acids dissolve in bases, and vice versa.

Increasing the temperature of the solution generally increases the solubility of the solute. It is well known that more sugar will dissolve in hot water than will in cold. The exception to this rule is where the solute is a gas. The solubility then decreases with an increase in temperature.

An increase in pressure aids the solution of a gas in a liquid or solid but has little or no effect on the solubility of a solid or liquid in a liquid.

All gases are completely soluble in one another.

Concentration and the measures of concentration.—The problem of how best to express the concentration of a solution is complicated by the many ways that solutions are used.

The terms "dilute" and "concentrated" have little meaning except as applied to specific solutions. The only general interpretation is that the concentrated solution of a given substance contains more than a dilute solution of the same substance.

A common measure of concentration is the percent (%) composition or grams of solute per 100 grams of solution. Sometimes the designation % W/V is encountered which means the grams of solute in 100 cubic centimeters of solution.

It is sometimes convenient, as in dealing with the concentration of body fluids, to use the term milligrams percent (mg. %). This indicates the number of milligrams of solute in 100 grams (or cubic centimeters) of solution.

In dealing with chemical compounds, knowing the number of molecules involved is frequently more convenient than knowing the actual weights involved. Therefore, a measure of concentration called molarity (M) is used. By definition a molar (1 M) solution is one which contains 1 mole (G. M. W., gram-molecular weight, or the number of grams of the substance equal to the

molecular weight of that substance) of solute in each liter of solution. *For example:*

1 M HCl contains 1 mole or 36.465 gm. of HCl in 1 liter of solution.

2 M NaCl contains 2 moles or 116.908 gm. of NaCl in 1 liter of solution.

0.2 M NaCl contains 0.2 moles or 11.6908 gm. of NaCl in 1 liter of solution.

Sometimes, especially in analytical work where there are unknown factors involved, it is useful to work with solutions with concentrations expressed in terms of chemical equivalence. For example in the reaction:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

1 mole of HCl is equivalent to 1 mole of NaOH, but in the reaction:

$$2HCl + Ca(OH)_2 \rightarrow CaCl + 2H_2O$$

1 mole of HCl is equivalent to only ½ mole of $Ca(OH)_2$.

The measure of concentration designating chemical equivalence is normality. A normal solution (1 N) is one which contains 1 gram equivalent weight (G. E. W. or equivalent) of solute in one liter of solution. The actual weight of one equivalent depends on the type of reaction involved.

In the reactions of acids with bases, the equivalent weight of an acid is equal to the molecular weight of the acid divided by the number of replaceable hydrogens in 1 molecule of the acid. E. g., the equivalent weight of

$$H_2SO_4 = \frac{98.082}{2} = 49.041 \text{ grams.}$$

The equivalent weight of a base is equal to the molecular weight of the base divided by the number of replaceable hydroxide ions ($.OH^-$) in the base. E. g., the equivalent weight of

$$Al(OH)_3 = \frac{91.194}{3} = 30.368 \text{ grams.}$$

The term "saturated" often appears in connection with solutions. The best definition of this term is as follows: A solution is saturated at a given temperature and pressure if the addition of more solute fails to alter the concentration.

The concentration of an unsaturated solution will increase upon addition of more solute. On the other hand, the excess solute in a supersaturated solution will precipitate on adding more of the undissolved solute, thus decreasing the concentration of the original solution.

ORGANIC CHEMISTRY

Organic chemistry is the chemistry of carbon compounds; these compounds were originally obtained only as products of organized life, i. e., plants and animals. As late as 1828, it was generally believed that a vital force was necessary to produce organic compounds from the elements. It was in that year that Wöhler, a German chemist, prepared Urea, unquestionably an organic compound, from purely inorganic reagents.

Today, a sparkling array of organic compounds are prepared synthetically. Every year hundreds more yield to the persistent attacks of research. In March of 1952, morphine, after more than 125 years of intensive research, was completely synthesized for the first time.

There are still many organic compounds which for practical or technical reasons are still prepared from living sources. Notable among these are drugs such as morphine, penicillin, or aureomycin and foods such as sugar, fats, and oils. Petroleum serves as a source of materials for the preparation of a great number of things which we use daily such as plastics, fabrics, paints, dyes, fuels, and foods.

The simple fact that carbon atoms can be linked together to form long chains, branches, and rings makes possible an almost infinite number of compounds having an equivalent number of properties.

Isomerism.—In the study of inorganic compounds the use of empirical or molecular formulas is generally quite sufficient. However, even molecular formulas do not always describe an organic compound. Take for example, C_2H_6O. This formula describes two compounds, di methyl ether and ethyl alcohol. The ether is a dangerously toxic gas while the alcohol is a narcotic liquid. This phenomenon is called isomerism. Isomers are compounds having the same molecular formula but different properties.

Structural formulas.—The properties of organic compounds do not depend so much on the kinds of elements comprising them as they do on the way in which these elements are linked together. In the same way boats, houses, furniture,

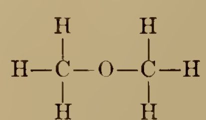
and phone poles are all made of wood but serve different purposes. Structure, then, is the key to organic chemistry.

First the student should understand that these compounds are three dimensional and that the formulas on paper merely represent the compounds and are not life images of them.

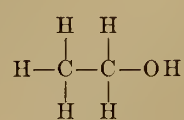
In the vast majority of cases the valence of carbon is four, oxygen is two, and hydrogen is one. In writing a structural formula, the student should always check to make sure the valence of all the atoms is properly satisfied.

The following examples show the usefulness of structural formulas in describing isomers.

Graphic structural formulas:



Dimethyl ether



Ethyl alcohol

Modified structural formulas:

$CH_3CH_2CH_2OH$

Normal propyl alcohol

CH_3CHCH_3
 |
OH

Isopropyl alcohol

Homologous Series

In the study of any chemistry it is convenient to group similar compounds together. In organic chemistry these groups or families are called Homologous Series.

Members of an homologous series have the same general formula, similar chemical properties and differ from each other by one or more methylene ($-CH_2-$) groups.

The Alkanes—(Saturated or Paraffin Hydrocarbons).—Since the naming of many series of organic compounds is based on this group, it will be studied first. These are compounds containing only hydrogen and carbon. They fit the general formula C_nH_{2n+2}, where $_n$ is the number of carbons in the compound. Practically all of them occur naturally in petroleum.

The simplest possible compound conforming to this general formula is methane (CH_4). The following table lists the first ten members of the series with the calculated number of isomers and the boiling points of the normal (unbranched) isomers.

Name	Molecular formula	Number of isomers	Boiling point of normal isomer
			Degrees C.
Methane	CH_4	1	−161
Ethane	C_2H_6	1	−88
Propane	C_3H_8	1	−45
Butane	C_4H_{10}	2	+0.6
Pentane	C_5H_{12}	3	36
Hexane	C_6H_{14}	5	69
Heptane	C_7H_{16}	9	98
Octane	C_8H_{18}	18	126
Nonane	C_9H_{20}	35	150
Decane	$C_{10}H_{22}$	75	174

A look at the boiling points listed shows the effect of increasing the length of the carbon chain on the boiling point. Other properties are modified in a similar predictable fashion.

Isomerism also affects the properties. As an example, take the isomeric butanes.

n-butane $CH_3CH_2CH_2CH_3$ bp = +0.6° C.

iso-butane CH_3CHCH_3 bp = −10° C.
 |
CH_3

The "alkyl" radicals or hydrocarbon groups that branch from the principal chain of carbons derive their names from the corresponding alkanes. They are designated by substituting the ending, "yl" for the "-ane" of the alkane from which they are derived.

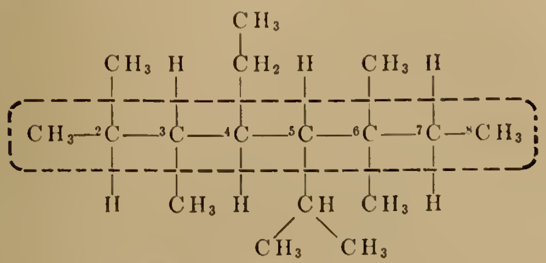
Common alkyl radicals

a. CH_3- methyl.
b. CH_3CH_2- ethyl.
c. $CH_3CH_2CH_2-$ n-propyl.
d. CH_3CH- iso propyl.
 |
CH_3
e. $CH_3CH_2CH_2CH_2-$ n-butyl.
f. $CH_3CH_2CHCH_3-$ sec-butyl.
g. CH_3CHCH_2- iso-butyl.
 |
CH_3
h. CH_3CCH_3- tert-butyl.
 |
CH_3
i. $CH_3CH_2CH_2CH_2CH_2-$ n-amyl.

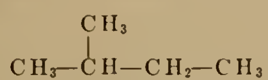
In 1922, the International Union of Chemistry met to reform the nomenclature of organic compounds. The I. U. C. system was the result of their efforts and is the system now generally accepted.

According to this system, compounds are named as derivatives of the longest continuous chain of carbons. The carbons are numbered consecu-

tively from one end of the chain to the other. The position of each substituting group is designated by the number of the carbon to which it is attached.



2,3,6,6,tetramethyl-4,ethyl-5 iso propyl octane



2-methyl butane

Petroleum serves as a source of a great many alkanes. They are separated by a process known as fractional distillation. This process is based on the fact that compounds having different boiling points may be separated by controlling the temperature so that the lower boiling compounds will escape as gases and the higher boiling compounds remain behind, the gases being caught and condensed.

The alkanes, as a group, are relatively unreactive. They will react with the halogens such as chlorine only if the reaction is catalyzed by ultraviolet light.

$$\underset{\text{Methane}}{CH_4+Cl_2} \xrightarrow[\text{Light}]{\text{UV}} \underset{\text{Methylchloride}}{CH_3Cl+HCl}$$

or

$$\underset{\text{Methane}}{CH_4+3Cl_2} \xrightarrow{\text{UV Light}} \underset{\text{Chloroform}}{CHCl_3+3HCl}$$

They will react with oxygen in aii to form carbon dioxide and water.
For example:

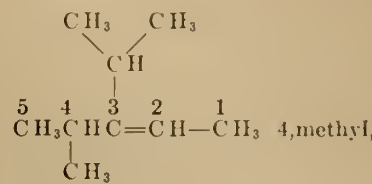
$$CH_4+2O_2 \longrightarrow CO_2+2H_2O$$

This is the type of reaction that occurs in the burning of gasoline.

Unsaturated Hydrocarbons Alkenes (Olefins)

These are compounds of hydrogen and carbon that fit the general formula C_nH_{2n}. The simplest member of this series, is ethylene $H_2C=CH_2$. According to the IUC system, these compounds are named as derivatives of the corresponding alkane having the same number of carbons. That is, the longest continuous carbon chain containing the unsaturated linkage (the double bond), takes the name of the corresponding alkane. The ending "ane" is dropped and the ending "ene" is added. For example:

$CH_3CH=CH_2$ propene (or propylene)



4,methyl, 3 isopropyl pentene-2

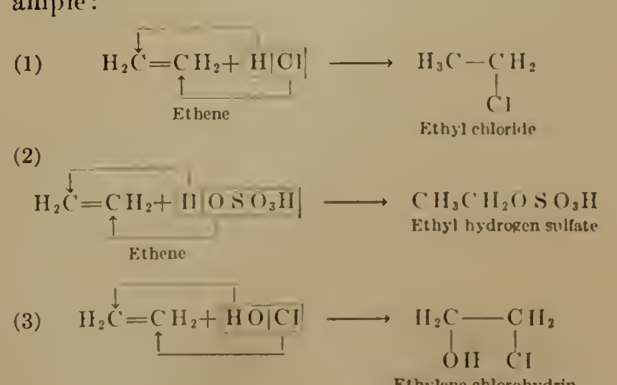
The position of the double bond being designated by the number of the lowest numbered carbon to which it is attached. The presence of a double bond in a compound increases the number of isomers possible. This is because the double bond may occur between any two carbons.

$CH_3CH=CHCH_3$ Butene, 2
$CH_2=CHCH_2CH_3$ Butene, 1

These compounds result from the cracking process of petroleum. This process is the breakdown of long chain hydrocarbons through the action of heat to form hydrocarbons having shorter carbon chains. They may also be prepared by the reaction of an alkyl halide with an alcoholic solution of potassium hydroxide.
$CH_3CH_2Cl+\text{Alc }KOH \rightarrow H_2C=CH_2+KCl+H_2O$
or by the dehydration of an alcohol by a strong dehydrating agent.
$CH_3CH_2CH_2OH+P_2O_5 \rightarrow CH_3CH=CH_2+HPO_3$

The olefins are more reactive than the alkanes due to their unsaturated structure.

Certain acids will "add across" the double bond. That is, one part of the acid will give to one carbon and another part will give to the other. Example:



(1) Ethene → Ethyl chloride

(2) Ethene → Ethyl hydrogen sulfate

(3) Ethylene chlorohydrin

Certain elements, such as hydrogen and the halogens, will also add to saturate the double bond.

(1) $H_2C{=}CH_2 + H_2 \longrightarrow CH_3CH_3$
Ethylene — Ethane

(2) $H_2C{=}CH_2 + Cl_2 \longrightarrow H_2C(Cl){-}CH_2(Cl)$
Ethene — dichloroethylene or 1,2,di-chloro ethane

The olefins will polymerize. This means that they are capable of reacting with themselves under special conditions to form very large compounds called polymers. These compounds are some of the plastics you know and use every day. The type of reaction is as follows:

$$H_2C{=}CH_2 + \boxed{\begin{matrix}H\\ C{=}CH_2\\ H\end{matrix}} \xrightarrow[\text{high pressure}]{\text{catalyst}} CH_3CH_2CH{=}CH_2$$

This reaction continues as long as a double bond remains in the product and as long as the conditions of reaction are applied.

$$CH_3CH_2CH{=}CH_2 + \boxed{\begin{matrix}H\\ CH{=}CH_2\end{matrix}} \longrightarrow CH_3CH_2CH(CH_3){-}CH{=}CH_2$$

and so on. The final polymer in this case is polyethylene:

$$CH_3CH_2(-CH_2-CH_2-)_nCH-CH_2$$

where $_n$ is 400–500.

Strong oxidation again yields carbon dioxide and water. This incidentally is true of most organic compounds. Milder oxidation will split olefins at the double bond giving as products, organic oxygen compounds having structures dependent on the structure of the olefin.

$$\underbrace{CH_3-CH}={\underbrace{CHCH_2CH_3}} + [O] \longrightarrow \overbrace{CH_3C(=O)-OH} + \overbrace{CH_3CH_2C(=O)-OH}$$

If two double bonds occur in a compound, it is called a -diene, with the position of each double bond being designated by the number of the lowest numbered carbon to which each is attached.

$$\overset{1}{C}H_2{=}\overset{2}{C}H{-}\overset{3}{C}H{=}\overset{4}{C}H_2 \qquad \text{Butadiene 1,3}$$

With greater numbers of double bonds, a similar system is followed.

Alkynes (acetylenes).—These unsaturated hydrocarbons, fitting the general formula C_nH_{2n-2}, are characterized by the presence of a triple bond. The most important member of the series is acetylene $HC{\equiv}CH$.

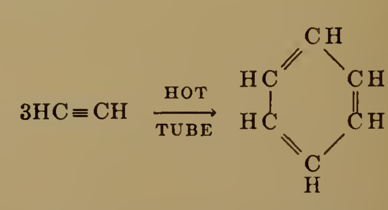
Acetylene may be prepared by the hydrolysis of calcium carbide, CaC_2.

$$CaC_2 + 2H_2O \longrightarrow HC{\equiv}CH + Ca(OH)_2$$
Calcium carbide — Acetylene

The properties of acetylene are similar to those of ethylene in that acids, certain elements and hydrocarbons will add across the unsaturated linkage. In addition, acetylene can be made to react with certain metals such as silver and copper to form compounds called acetylides

$$HC{\equiv}CH + Cu_2Cl_2 + NH_4OH \longrightarrow \underbrace{CuC{\equiv}CCu}_{\text{copper acetylide}} + H_2O + NH_4Cl$$

Acetylene polymerizes with such ease that it is dangerous to subject it to much pressure. In order to store and ship acetylene safely, it is dissolved in acetone, within tanks, under pressure. When acetylene, is passed through a hot tube, it trimerizes to form a ring-shaped compound called benzene.



The halogen derivatives of hydrocarbons.—These are compounds of hydrogen, carbon and a halogen. They are important not only as pure organic chemicals, but also as anaesthetics (chloroform, ethylchloride), insecticides, and in plastics. They may be prepared by the reaction of a halogen acid with an olefin or by the halogenation of

alkanes. Alcohols will react with either halogen acids or phosphorous halides to give alkyl halides.

(1) $\underset{\text{Ethyl alcohol}}{CH_3CH_2OH} + HCL \longrightarrow \underset{\text{Ethyl chloride}}{CH_3CH_2Cl + H_2O}$

(2) $3CH_3CH_2OH + PI_3 \longrightarrow \underset{\text{Ethyl iodide}}{3CHCH_2I + P(OH)_3}$

These compounds may be used to prepare many organic substances. An active metal will split out the halogen and the alkyl residues will couple to double the carbon chain. Example:

$$\underset{\text{ethyl iodide}}{2CH_3CH_2I + 2Na} \longrightarrow \underset{\text{n-butane}}{CH_3CH_2CH_2CH_3 + 2NaI}$$

A valuable organic reagent called the "Grignard" reagent is formed by the reaction of an alkyl halide with metallic magnesium in dry ether.

$$CH_3Br + Mg \xrightarrow[\text{ether}]{\text{dry}} CH_3MgBr \quad \text{Methyl Grignard or methyl magnesium bromide}$$

Alkyl halides can react with salts to form a variety of organic compounds.

(1) $\underset{\text{Methyl iodide}}{CH_3I} + \underset{\text{Sodium cyanide}}{NaCN} \longrightarrow \underset{\text{Methyl cyanide (a nitrile)}}{CH_3CN} + NaI$

(2) $CH_3I + \underset{\text{Sodium methoxide}}{NaOCH_3} \longrightarrow \underset{\text{Dimethylether}}{CH_3OCH_3} + NaI$

(3) $CH_3I + \underset{\text{Sodium nitrite}}{NaNO_2} \longrightarrow NaI + \underset{\text{Nitro methane}}{CH_3NO_2}$

(4) $CH_3I + \text{aqueous } NaOH \longrightarrow \underset{\text{Wood alcohol or methyl alcohol}}{CH_3OH}$

Compounds Containing Oxygen

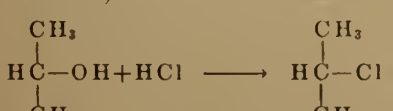
Alcohols are characterized by the presence of the hydroxyl radical. They are divided into three classifications.

Primary alcohols are those where the hydroxyl is attached to a terminal carbon.

$$CH_3CH_2OH = \text{ethyl alcohol}$$
$$CH_3CH_2CH_2OH = \text{n-propyl alcohol}$$

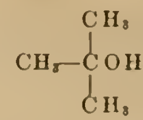
These react slowly with HCl.

Secondary alcohols having the hydroxyl attached to a carbon to which are attached two alkyl radicals, react with HCl at a moderate rate.



iso propyl (a secondary alcohol)

Tertiary alcohols have the hydroxyl on a tri-substituted carbon.



Tert-butyl alcohol

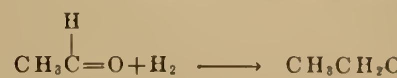
The reaction of tertiary alcohols with HCl is rapid.

Primary alcohols may be prepared in the following manner:

1. By alkaline hydrolysis of the corresponding alkyl halides.

$$CH_3I + HOH \xrightarrow{KOH} CH_3OH + HI \quad \text{methanol}$$

2. By hydrogenation of an "aldehyde."



ethanol

3. By hydrolysis of an alkyl hydrogen sulfate.

$$\underset{\text{Ethyl hydrogen sulfate}}{CH_3CH_2OSO_3H} + HO \longrightarrow CH_3CH_2OH + H_2SO_4$$

This is a good commercial synthesis.

Certain alcohols are made by special processes such as:

Methyl alcohol (wood alcohol) by the dry distillation of wood.

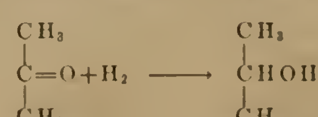
Ethyl alcohol (grain alcohol) by the enzymatic fermentation of the sugars found in plants.

Methyl alcohol is exceedingly poisonous, doing permanent damage to the optic nerve. Its use is generally restricted to its solvent properties and as a starting material in the preparation of certain organic compounds. Ethyl alcohol, on the other hand, is not as deadly a poison, but its continued use damages the liver and causes undesirable social changes in an individual. The sale of ethanol is subject to strict federal regulation. It is widely used as a solvent in pharmacy to prepare tinctures, extracts, and elixirs.

Secondary alcohols may be prepared:

1. By the hydrolysis of the corresponding alkyl halide.

2. By the hydrogenation of a ketone.



Acetone — Iso propyl alcohol or propanol—2

The reactions are similar to those of primary alcohols except that the hydroxyl is more easily replaced.

Tertiary alcohols are best prepared by the reaction of a Grignard reagent with a ketone.

$$\begin{array}{c} CH_3 \\ | \\ C{=}O \\ | \\ CH_3 \end{array} + CH_3MgBr \longrightarrow \text{intermediate hydrolysis} \longrightarrow \begin{array}{c} CH_3 \\ | \\ CH_3{-}COH \\ | \\ CH_3 \end{array}$$

Acetone — Tertiary butyl alcohol, 2-methyl propanol-2

Properties of the alcohols.—Primary alcohols oxidize to give aldehydes which on further oxidation yield acids:

(*a*) $CH_3CH_2OH+[O] \longrightarrow CH_3\overset{\overset{\displaystyle O}{\|}}{C}{-}H$

Ethanol — Ethanal (acetaldehyde)

(*b*) $CH_3\overset{\overset{\displaystyle O}{\|}}{C}{-}H+[O] \longrightarrow CH_3\overset{\overset{\displaystyle O}{\|}}{C}{-}H$

Ethanal — Ethanoic acid (acetic acid)

Secondary alcohols oxidize to give ketones:

$CH_3CHOHCH_3+[O] \longrightarrow CH_3COCH_3$

Iso propyl alcohol, propanol-2 — Acetone, propanone

Tertiary alcohols give a mixture of acids on oxidation.

The hydrogen of the hydroxyl may be replaced directly by an active metal or an acid radical.

$CH_3CH_2OH+Na \longrightarrow CH_3CH_2ONa+H_2$

$CH_3CH_2O\boxed{H+HO}SO_3H \longrightarrow CH_3CH_2O{-}SO_3H$

or, indirectly by an alkyl radical to form an "ether."

1. $CH_3CH_2OH+PI_3 \longrightarrow CH_3CH_2I$
2. $CH_3CH_2OH+Na \longrightarrow CH_3CH_2ONa$
3. $CH_3CH_2ONa+CH_3CH_2I \rightarrow CH_3CH_2{-}O{-}CH_2CH_3$

Diethyl ether

The hydroxyl may be replaced by a halogen to give an alkyl halide.

The simpler alcohols are named by naming the radical attached to the hydroxyl and calling it an alcohol. By the IUC system, the "e" is dropped from the name of the longest carbon chain containing the "functional group" ($\equiv$COH), adding "–ol" and numbering the position of –OH with the number of the carbon involved. Another system still in use names alcohols as derivatives of "carbinol," another name for methyl alcohol.

Ethers

Ethers are substances which may be considered to be derived from alcohols. Their structure is two alkyl radicals attached to an oxygen. (R–O–R′, where R and R′ represent alkyl radicals.) They may be prepared by the reaction of an alcohol with phosphorous pentoxide. Example:

$CH_3CH_2OH \xrightarrow{P_2O_5} CH_3CH_2{-}O{-}CH_2CH_3$

Ethyl alcohol — Diethyl ether

They may also be prepared by the interaction of an alkyl halide and the sodium salt of an alcohol.

$CH_3I+NaOCH_2CH_3 \longrightarrow CH_3OCH_2CH_3$

Methyl iodide+sodium ethoxide ⟶ methyl ethyl ether

These compounds are relatively inert. One of the few chemical properties characteristic of this class is their reaction with hot concentrated halogen acids. Example:

$CH_3CH_2OCH_2CH_3+2HI \longrightarrow 2CH_3CH_2I+H_2O$

Diethyl ether

Di ethyl ether is the most familiar member of this class. It is a good solvent. Being insoluble in water, it is useful in extracting certain compounds from water solutions. Its use as an anaesthetic under the common name "ether" is well known.

Aldehydes and Ketones

These compounds, generally having aromatic odors, can be considered as being derived from alcohols. In fact, the word aldehyde is derived from dehydrogenated alcohols. Both aldehydes and the ketones are characterized by the presence of the "carbonyl" ($>C{=}O$) group. In the case of aldehydes, the carbonyl is the terminal or primary carbon, while the carbonyl in ketones, is a secondary carbon.

Aldehydes may be prepared by the partial oxidation or dehydrogenation of the corresponding primary alcohol.

$CH_3CH_2OH+[O] \longrightarrow CH_3\overset{\overset{\displaystyle O}{\|}}{C}{-}H+H_2O$

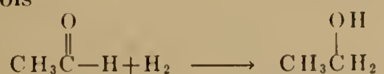
Ketones are prepared by oxidizing the secondary alcohol having the same number of carbons.

$$\begin{array}{l} CH_3CHOH+[O] \\ \quad | \\ \quad CH_3 \end{array} \xrightarrow{KMnO_4} CH_3CHOCH_3$$

Compounds containing a carbonyl group react in several manners:

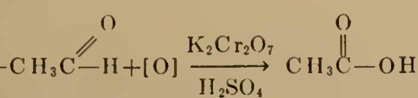
1. By addition across the double bond to form, for example, cyanohydrins

and alcohols

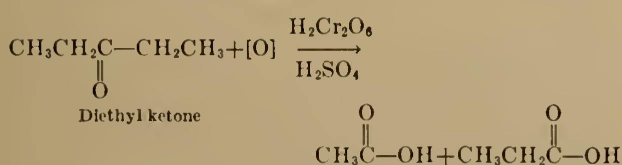


2. By oxidation to form acids

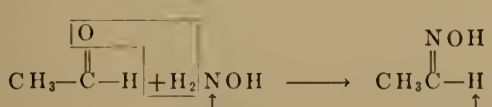
Aldehydes.—



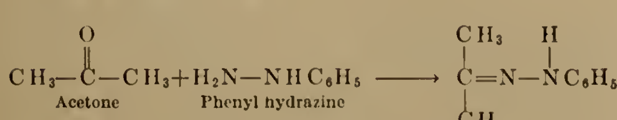
Ketones.—Are oxidized with greater difficulty to form acids having fewer carbons.



3. By condensation, that is, the loss of water from the two compounds, forming as products, oximes:



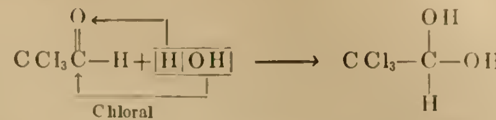
or phenyl hydrazones:



This type of reaction is typical of all carbonyl compounds.

4. Halogens easily substitute the hydrogens next to the carbonyl group:

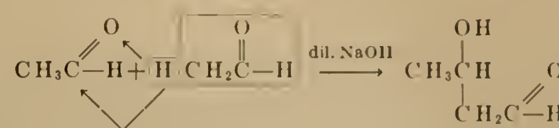
Water will react with chloral to form chloral hydrate



famous for its sedative properties.

5. The oxygen is substituted by the action of phosphorous penta chloride

6. Polymerization is catalyzed by the action of strong acids and bases.



The above is the type of reaction involved.

Ketones are distinguished from aldehydes by their failure to form certain addition products and by the greater resistance they offer to oxidation.

Aldehydes and ketones are named by substituting the ending "-aldehyde" for the "ic" in the name of the acid which they yield on oxidation. For example: Acet-aldehyde oxidizes to yield acetic. In the IUC system, the ending "-al" is substituted for the ending "-e" of the corresponding alkane. For example:

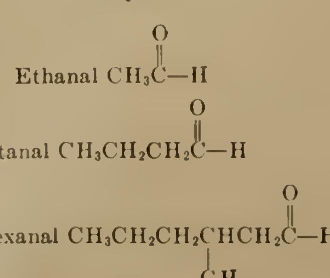
Alkane

Ethane CH_3CH_3

Butane $CH_3CH_2CH_2CH_3$

3 methyl hexane $CH_3CH_2CH_2CHCH_2CH_2$ (branch: CH_3)

Aldehyde



Since the carbonyl of an aldehyde is always the terminal carbon, there is no need to designate its

position with a number. It is therefore, always carbon number one.

Ketones are also named according to the acids they yield on oxidation. *For example.*—Acetone oxidizes to give acetic acid. This system is limited in use. Another method is by naming the alkyl radicals attached to the carbonyl group and calling the compound a ketone. *Example:*

$$CH_3CH_2\overset{O}{\overset{\|}{C}}-CH_3 \quad \text{Methyl ethyl ketone}$$

The IUC system designates a ketone with the ending "-one" and the number indicating its relative position in the longest continuous carbon chain:

$$CH_3\underset{\underset{CH_3}{|}}{C}H\overset{O}{\overset{\|}{C}}CH_3 \quad \text{3 methyl butanone 2}$$

Organic acids are characterized by the presence of the carboxyl group ($-\overset{O}{\overset{\|}{C}}-OH$). The hydrogen in the carboxyl group is easily replaced and is, therefore, responsible for the acid properties of these compounds. Acids were some of the first organic compounds to be classified. Therefore, they have individual names by which they are commonly known. The following table lists some of the common acids with the formulas and IUC names.

Acid (common name)	Formula	IUC name
Formic acid	$HCOOH$	Methanoic acid.
Acetic acid	CH_3COOH	Ethanoic acid.
Propionic acid	CH_3CH_2COOH	Propanoic acid.
n-butyric acid	$CH_3CH_2CH_2COOH$	Butanoic acid.
Palmitic acid	$CH_3(CH_2)_{14}COOH$	Hexadecanoic acid.
Stearic acid	$CH_3(CH_2)_{16}COOH$	Octadecanoic acid.

They are formed by the oxidation of the corresponding alcohol or aldehydes. *Example:*

$$a.\ \underset{\text{ethanol}}{CH_3CH_2OH}+[O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} \underset{\text{acetic acid or ethanoic acid}}{CH_3COOH}$$

$$b.\ \underset{\text{acetaldehyde}}{CH_3CHO}+[O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3COOH$$

Their properties are, of course, similar to those of inorganic acids in that they react with bases to form salts.

$$\underset{\text{Acetic acid}}{CH_3COOH+NaOH} \longrightarrow \underset{\text{Sodium acetate}}{CH_3COONa+H_2O}$$

With alcohols, they will combine to form esters.

$$CH_3COOH+CH_3CH_2OH \leftrightarrows \underset{\text{Ethyl acetate (an ester)}}{CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_3+H_2O}$$

Many acids occur in nature as esters and are commercially prepared from them. For example, palmitic acid occurs as an ester in coconut oil. Butyric acid occurs free in rancid butter, or as an ester in fresh butter.

Some of the other important derivatives of the organic acids may be prepared as follows: The OH of the carboxyl may be replaced by the action of phosphorus trichloride. *Example:*

$$3CH_3COOH+PCl_3 \longrightarrow \underset{\text{Acetyl chloride (an acid chloride)}}{3CH_3\overset{O}{\overset{/\!/}{C}}-Cl+P(OH)_3}$$

Acid chlorides will react with any compound having an active hydrogen. *Example:*

$$\boxed{CH_3O\boxed{H}}+CH_3CO\boxed{Cl} \longrightarrow \underset{\text{Methyl acetate}}{CH_3\overset{O}{\overset{\|}{C}}OCH_3+HCl}$$

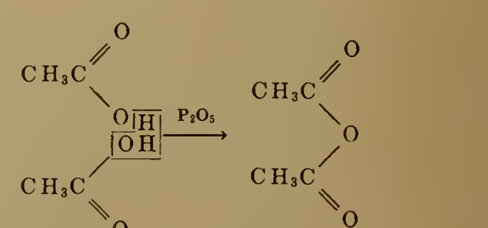
Heroin, an ester of morphine, can be prepared only in this fashion.

Acid chlorides will react with ammonia and alkyl derivatives of ammonia to form a class of compounds called amides. Proteins and nylon are compounds of this type.

$$CH_3COCl+\underset{\text{Methyl amine}}{H_2NCH_3} \quad CH_3\overset{O}{\overset{\|}{C}}-NHCH_3+HCl$$

N methyl acetamide (the N means that the methyl group is attached to the nitrogen)

The anhydrides of acids are formed by the removal of one molecule of water from two carboxyl groups.



Acetic anhydride

Fats and Oils

The vegetable and animal fats and oils are preponderantly esters of long-chain fatty acids with glycerin (1-2-3 propanetriol—this means there is an alcoholic OH substituted on each of the carbons of propane). For example: Tripalmitin in the

tri-ester of one molecule of glycerin with three of palmitic acid. Tributyrin is the tri-ester of glycerin and butyric acid. Waxes are esters of long chain alcohols and fatty acids. For example: beeswax is myricyl palmitate $(C_{15}H_{31}\overset{O}{\overset{\|}{C}}-OC_{31}H_{63})$

Compounds Containing Nitrogen

Amines.—This family of compounds may be considered as being derived from ammonia. The compounds in this group may be divided into three subgroups according to the number of alkyl groups attached to the nitrogen atom.

Parent compound	$H-\underset{H}{\overset{H}{\underset{\mid}{\overset{\mid}{N}}}}$ written as $N(H)(H)-H$	ammonia
Primary amine (1 alkyl group)	$\overset{H}{\overset{\mid}{N}}(\underset{H}{\mid})-CH_2CH_3$	ethyl amine
Secondary amine (2 alkyl groups)	$\overset{CH_2CH_3}{\overset{\mid}{N}}(\underset{H}{\mid})-CH_2CH_3$	diethyl amine
Tertiary amine (3 alkyl groups)	$\overset{CH_2CH_3}{\overset{\mid}{N}}(\underset{CH_2CH_3}{\mid})-CH_2CH_3$	triethyl amine

They may be prepared by the addition of an alkyl halide to ammonia $CH_3CH_2I+NH_3=CH_3CH_2NH_3I$ ethyl ammonium iodide or ethyl amine hydroiodide. This product is the salt of the amine. The free amine is readily obtained by treatment of the amine salt with a strong base such as sodium hydroxide.

$$\underset{\text{Ethylamine hydroiodide}}{CH_3CH_2NH_3I}+NaOH=\underset{\text{Ethyl amine}}{CH_3CH_2NH_2}+NaI+H_2O$$

They may also be prepared by the reaction of a nitro alkane with hydrogen:

$$\underset{\text{Nitro methane}}{CH_3NO_2}+6H_2=\underset{\text{Methyl amine}}{CH_3NH_2}+2H_2O$$

The secondary and tertiary amines may be prepared from primary amines by their reaction with alkyl halides.

(*a*) $CH_3CH_2NH_2+CH_3CH_2I \longrightarrow \underset{\text{Diethylamine hydroiodide}}{(CH_3CH_2)_2NH_2I}$

(*b*) $(CH_3CH_2)NH_2I+NaOH \longrightarrow \underset{\text{Diethylamine, a secondary amine}}{(CH_3CH_2)_2NH+NaI+H_2O}$

(*c*) $(CH_3CH_2)_2NH+CH_3CH_2I \longrightarrow \underset{\text{Triethylamine hydroiodide}}{(CH_3CH_2)_3NHI}$

(*d*) $(C_2H_5)_3NHI+NaOH \longrightarrow \underset{\text{Triethylamine}}{(C_2H_5)_3N}+NaI+H_2O$

Reactions.—Two of the most typical properties of amines are their salt formation above and the relative activity of the hydrogens attached to the nitrogen. The amines are the bases of organic chemistry, and assume this role in the formation of salts.

$$CH_3CH_2NH_2+HCl \longrightarrow \underset{\text{Ethylamine hydrochloride}}{CH_3CH_2NH_3Cl}$$

Tertiary amines form salts, called tetra alkyl ammonium compounds, with alkyl halides

$$(CH_3)_3N+CH_3I=\underset{\text{Tetra methyl ammonium iodide}}{(CH_3)_4NI}$$

Some of these tetra alkyl ammonium compounds have been found to be efficient bactericides. As a result, a startling array of such compounds have been prepared and marketed recently.

The activity of the nitrogen-bound hydrogens is also worthy of note. For example.—An acid chloride will react with an amine which contains an "active" hydrogen (i. e., primary and secondary amines) but does not react with tertiary amines since they do not contain any nitrogen bound hydrogen.

(*a.*) $CH_3NH_2+\underset{\text{Acetyl chloride}}{Cl-\overset{O}{\overset{\|}{C}}-CH_3}=\underset{\text{N-methyl acetamide, an amide}}{CH_3-\overset{H}{\overset{\mid}{N}}-\overset{O}{\overset{\|}{C}}-CH_3}+HCl$

(*b.*) $(CH_3)_3N+Cl-\overset{O}{\overset{\|}{C}}-CH_3=$ no reaction

The product of reaction (*a*), called an amide, is characteristic of a large group of substances including nylon, drugs, and animal proteins.

Proteins.—At this point, brief mention should be made of proteins, the "fiber and sinew" of animals. The molecules of proteins are huge. Some are even visible under the electron miscroscope. On hydrolysis, they yield a mixture of amino acids, compounds containing the amine group, $-NH_2$, and an acid group $-\overset{O}{\overset{\|}{C}}-OH$.

Since amino acids contain both groups, it is possible to cause the amine group of one molecule to react with the acid group of another to form an amide, having a free amine group and a free acid group left open to reaction. By continuation

of this process, polymers having high molecular weights may be prepared which resemble natural proteins in many respects. Due to their tremendous complexity, the exact structure of proteins is not yet fully understood.

Carbohydrates.—These are the sugars, starches and wood-fibers which comprise such an essential part in our daily lives. Due to the brilliant fundamental researches of Emil Fischer, the chemistry of at least the simpler compounds is fairly well understood.

They are classified into three general groups, depending on their reaction to hydrolytic agents.

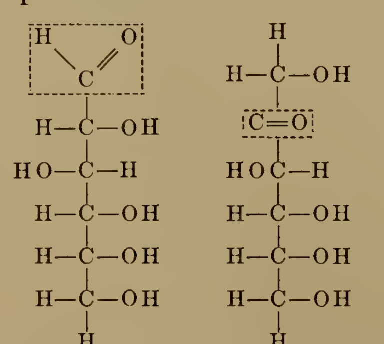
a. **Mono-saccharides.**—The simplest sugars do not hydrolyse (glucose, fructose, galactose, etc.).

b. **Di-saccharides.**—Yield two mono-saccharides on hydrolysis (sucrose, lactose, maltose, etc.).

c. **Poly-saccharides.**—Yield many sugars on hydrolysis (starch, glycogen, cellulose, etc.).

The mono and di-saccharides are sweet, crystalline, water soluble substances called sugars. The poly-saccharides are more or less tasteless, noncrystalline and are generally insoluble in water.

Mono-saccharides.—The most common monosaccharides contain 6 carbons. They are called hexoses. Analysis indicates that hexoses contain 5 alcohol groups and either one aldehyde or one ketone group. If a hexose contains an aldehyde group, it is called an aldohexose. If it contains a ketone group it is called a ketohexose.



Glucose, an aldohexose   Fructose, a ketohexose

The exact spatial arrangement of the atoms is important since it involves a special kind of isomerism called optical isomerism. There are 16 possible optical isomers that are aldohexoses.

Di-saccharides.—There are two types of disaccharides, depending on their ability to reduce (and be oxidized by) Fehlings solution (this is a readily reduced blue solution of copper^{++}. The formation of a reddish brown precipitate of copper^{+} indicates reduction). All mono-saccharides will reduce Fehling's solution.

Sucrose, cane sugar, is a non-reducing disaccharide which yields glucose and fructose on hydrolysis.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}}+H_2O \xrightarrow{\text{HCl}} \underset{\text{Glucose}}{C_6H_{12}O_6}+\underset{\text{Fructose}}{C_6H_{12}O_6}$$

Lactose, milk sugar, is a reducing di-saccharide which on hydrolysis produces glucose and galactose, both aldohexoses.

Poly-saccharides.—These are built up of long chains of di-saccharides. They are classified according to the size of their molecules, their hydrolysis products, and their behavior toward specific hydrolytic enzymes. For example, ptyalin, an enzyme found in saliva, will hydrolyse starch readily but does not cause the hydrolysis of cellulose (cotton).

The metabolism of carbohydrates.—Starches and sugars, taken orally, are hydrolyzed by the action of the enzymes and acids in the gastrointestinal tract. The mono-saccharides thus produced are absorbed through the small intestine into the blood stream. They are then transported via the portal vein to the liver which converts the glucose to glycogen (animal starch). It is stored in the liver to be released as the body demands. Some of the sugar in the blood stream is transported to the muscles for glycogen synthesis and storage as a quick source of energy. The energy is obtained by the oxidation of simple sugars to give CO_2 and water.

CYCLIC COMPOUNDS

These compounds are typified as containing ring-like groups of carbons as opposed to the open chains studied up until now. This family is subdivided according to the structure of the ring.

Aromatic compounds.—Ring structure similar to that of benzene, with all the atoms forming the

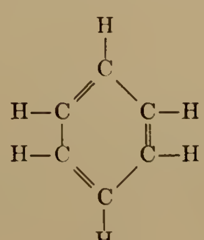
ring being of the same element (almost always carbon); e. g., benzene, toluene, naphthalene, phenol, etc.

Alicyclic compounds.—All atoms in the ring are of the same element, but the structure is not similar to benzene; e. g., cyclopropane, camphor, menthol, etc.

Heterocyclic compounds.—The ring structure may or may not be similar to benzene, but the atoms forming the ring are not all of the same element; e. g., uric acid, heroine, the barbiturates, thiazole.

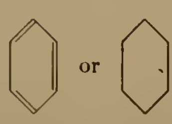
Of these subgroups, only the aromatic compounds have chemical properties sufficiently different to warrant discussion here. Although the other classes contain many compounds whose action as drugs is powerful and at times dramatic, they will be treated by simply giving some examples to illustrate their structures and relation to the other groups.

The aromatic hydrocarbons.—In the same way that methane can be considered as the fundamental aliphatic, or open-chain compound, benzene is the basis for the study of aromatic compounds. Benzene has the molecular formula C_6H_6. The majority of evidence derived from experiment indicates that the structure must be:

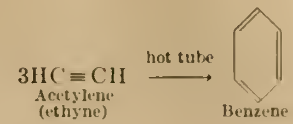


Benzene

The double bonds in benzene are not static but shift between carbon pairs. This is called "resonance" and is the property essential to an aromatic compound. For the sake of simplicity, however, the above structure is seldom used in the literature, but is usually abbreviated by merely drawing a hexagon

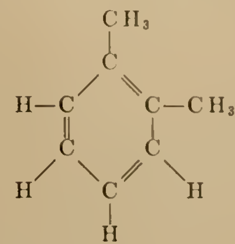


to indicate the benzene structure. Benzene may be obtained by the distillation of coal tar or by synthesis from acetylene.



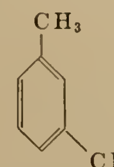
In naming the derivatives of benzene, two common systems are employed; *a.* by the relative positions of two substituted groups.

1. If the groups are on adjacent carbons, it is an ortho-derivative. This is designated with a small "o".



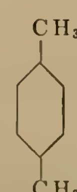
is o-dimethyl benzene or o-xylene

b. If the groups are separated by one carbon, it is a "meta" derivative. The small letter "m-" is used to indicate this:



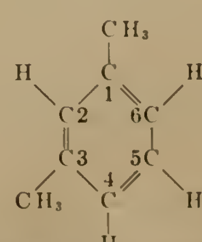
m-dimethyl benzene or m-xylene

c. If the groups are attached to diametrically opposed carbons, it is called a "para" derivative and is designated with a "p-".



p-dimethyl benzene or p-xylene.

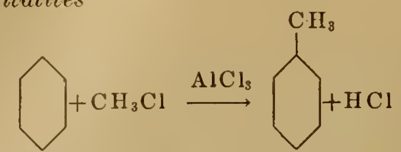
The other system, which is more versatile, numbers the carbons from 1 to 6 so that the groups are attached to the lowest numbered carbons. *Example:*



1,3dimethyl benzene or 3methyl toluene (m-xylene)

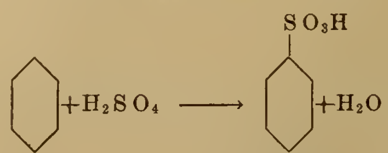
Properties of aromatic compounds.—Aromatic compounds will react with:

1. Alkyl halides in the presence of $AlCl_3$ to form *alkyl derivatives*



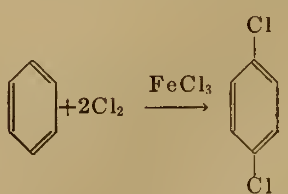
Benzene Methyl benzene, toluene

2. Sulfuric acid to form *sulfonic acids*



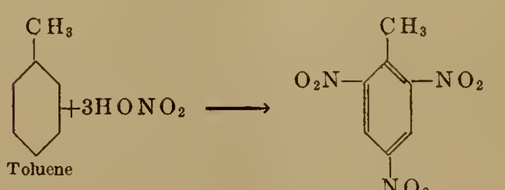
Benzene sulfonic acid

3. With halogens to form *aryl halides*



p di chloro benzene

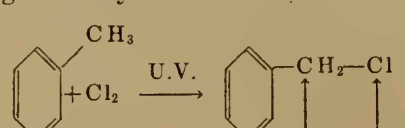
4. With nitric acid to form *nitro compounds.*



Toluene

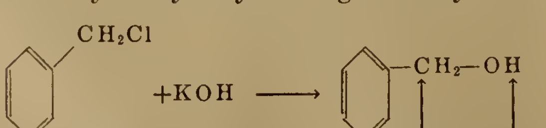
2,4,6,trinitrotoluene (TNT) or 1,methyl 2,4,6,trinitro benzene

From these derivatives others can be made. For example, toluene may be chlorinated, in the absence of $FeCl_3$ and the presence of ultra violet light to give benzyl chloride



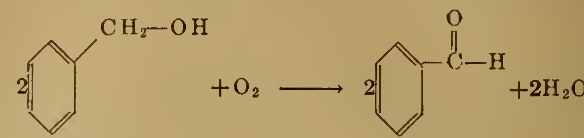
Toluene Benzyl Chloride

This may be hydrolyzed to give benzyl alcohol



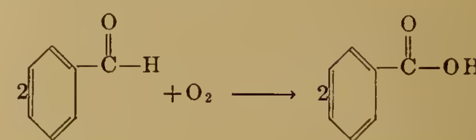
Benzyl chloride Benzyl Alcohol

which in turn may be oxidized to give benzaldehyde



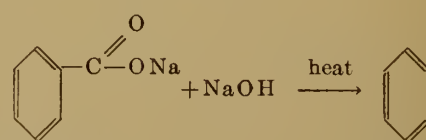
Benzyl alcohol Benzaldehyde

and finally benzoic acid.



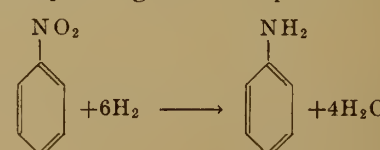
Benzaldehyde Benzoic acid

Sodium benzoate, the salt of benzoic acid, on heating with NaOH gives benzene.



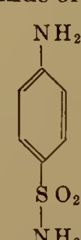
Sodium benzoate Benzene

As another example of the reactions of these compounds, aryl amines are formed by the reduction of the corresponding nitro compound.



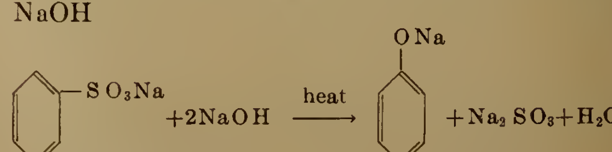
Nitro benzene Aniline or phenyl amine

Sulfanilamide is a derivative of benzene sulfonic acid. The "para" position on the ring contains an amine (*aniline*) group and the sulfonic group is converted to the amide of p-aniline sulfonic acid:



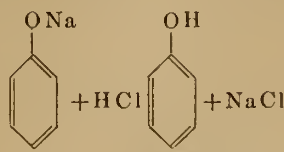
Sulfanilamide

Phenols, or *aryl hydroxy* compounds are formed by heating the sodium salt of a sulfonic acid with NaOH



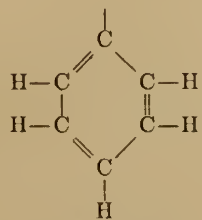
Sodium benzene sulfonate Phenol (salt)

and subsequent hydrolysis of the phenol-salt



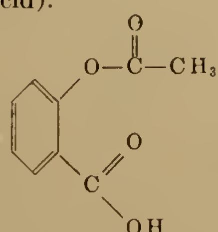
Phenol (free form)

It is from phenol that the phenyl radical derives its name.



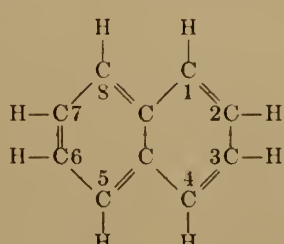
Phenyl radical

Aspirin is the acetic acid ester of o-hydroxy benzoic acid (salicylic acid).

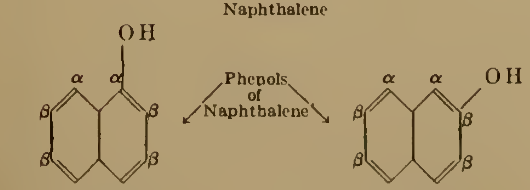


Acetyl salicylic acid (aspirin)

Naphthalene, a two-ring aromatic hydrocarbon, has properties similar to those of benzene



Naphthalene



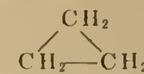
α. Naphthol 1,hydroxy naphthalene

β. Naphthol 2,hydroxy naphthalene

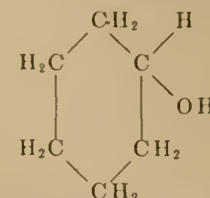
and is also obtained by the distillation of coal tar.

There are a great number of possible derivatives of these hydrocarbons. The properties shown give an index of the generalized chemical properties of the group as a whole.

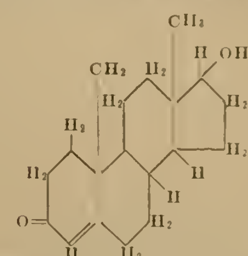
Alicyclic compounds: These ring compounds differ from aromatic compounds by the absence of resonance. Their properties resemble those of aliphatic compounds rather than those of aromatic compounds. Examples:



Cyclopropane—used as a general anaesthetic



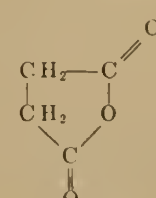
Cyclohexanol, prepared by hydrogenation of phenol, is used in the synthesis of nylon



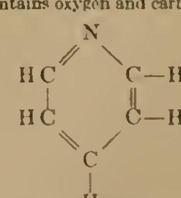
Testosterone—one of the sex hormones

HETEROCYCLIC COMPOUNDS

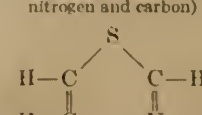
These may or may not have resonating structures. The family characteristic being that the ring contains at least one atom of an element different than the others.



Succinic anhydride (not resonating, ring contains oxygen and carbon)

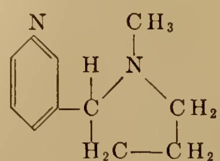


Pyridine (resonating structure, ring contains nitrogen and carbon)



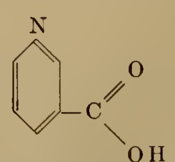
Thiazole (no resonance, ring contains sulfur, nitrogen and carbon)

These compounds include many groups of compounds among which are most of the plant alkaloids. These alkaloids are cyclic nitrogenous compounds having marked physiological activity. Since they are nitrogenous they act as bases—hence the name alkaloids. Examples:



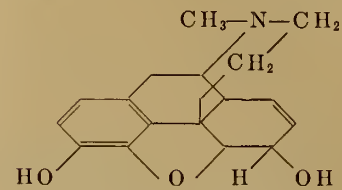
Pyridinic nucleus   Nicotine

Nicotine, found in tobacco, is a derivative of pyridine. It is a violent and highly toxic liquid having a strong odor. Oxidation of nicotine with nitric acid gives nicotinic acid, one of the "B" vitamins.



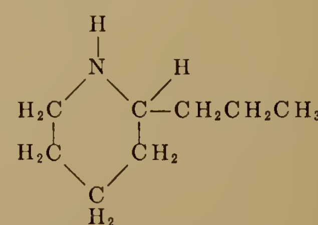
Nicotinic acid (niacin)

Morphine, derived from opium, has well known properties. Its structure is quite complex.



Morphine (this structure was proven in 1952 by Gates)

The structures of some alkaloids are not particularly complex. Coniine, for example, the active principle of poison hemlock (not water hemlock) has a relatively simple structure



Coniine

This is probably the substance which caused the death of Socrates.

Chapter X

LABORATORY TECHNIQUES AND PROCEDURES

BACTERIOLOGY

Introduction

Bacteriology, is the study of all bacteria. Medical bacteriology is the branch of bacteriology that deals with the microorganisms that cause disease in the animal body. Bacteria, minute single-celled organisms, are generally classified roughly according to their disease-producing ability. Those bacteria that cause disease are called pathogenes, and those that do not are called nonpathogenes or harmless bacteria.

Bacteria were not known by man to exist until about 1650, when Leeuwenhoek invented the first simple microscope. In 1850, Louis Pasteur proved that bacteria were the cause of many diseases of man.

There are many thousands of bacteria that have been discovered to date and classified, and it is estimated that there are a great many thousands yet to be discovered. Bacteria occur practically everywhere in great numbers. The normal human body harbors well over a hundred different species, and the numbers of each of these species that live in our bodies go well into the trillions.

Only a very small number of bacteria are pathogenic to man. Many bacteria are very beneficial, and human life could not exist without them. Bacterial decomposition helps to dispose of waste materials. Bacteria are very useful to us in many modern industries. The manufacture of many cheeses could not be accomplished without the aid of bacterial action. Alcohol manufacturing plants could not operate if it were not for useful bacteria.

This chapter will be limited to a study of a few of the important pathogenic bacteria that cause disease in man.

The most important single piece of apparatus in a laboratory is the microscope. Care must be taken to use and protect it properly. It is used to magnify and so make visible to the eye very small bodies, such as bacteria, the eggs of intestinal parasites, and the material found in urine sediments. A simple microscope is a single magnifying lens. A compound microscope, which is the type used in medical laboratories, consists of a number of such lenses arranged in line so as to give great magnification, even up to 1,000 times. The following precautions should always be observed in its use:

1. The microscope should always be kept covered when not in use.
2. Care should be used to keep all parts of the microscope from coming in contact with acids, alkalies, chloroform, alcohol, or xylol except as otherwise noted.
3. Lens paper should always be used in wiping dust from dry objectives, and oil should always be removed by moistening the lens paper with a drop of xylol, but a final wiping should be done with dry lens paper.
4. If oil is used on mechanical parts, all excess should be thoroughly wiped off to prevent the collection of dust and grit.
5. The microscope should be protected against direct sun and moisture.
6. The low power lens should always be centered when not in use.

The principal parts of the microscope are the base upon which the microscope stands, the stage where specimens are placed, the arm which holds the body tube, the objectives (three of which are located in the triple nosepiece), and the oculars (numbered according to their magnifying power). The ocular in use is located in the upper end of the body tube. The condenser with an iris diaphragm is used to control the light rays. The mirror has two sides—one concave and one flat surface. The flat surface of the mirror is employed when using ordinary daylight or some special types of lamps when color images are desired; but the concave mirror is used when ordinary ar-

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tificial light is used, as such rays are not parallel. The proper employment of illumination comes only with experience, and one should continue to manipulate the mirrors, diaphragm, and condenser until the proper light is obtained.

Proper illumination is very important in microscopic work; unless the light is utilized to the best advantage, the best results cannot be obtained. Direct sunlight or an excessively bright light is to be avoided or reduced by white shades or curtains. Most microscopists prefer to use special microscope lamps exclusively, in order to obtain a uniform illumination at all times.

The rule for determining the magnifying power of the objectives and oculars is the magnifying power of the objective multiplied by the magnifying power of the ocular. The magnifying power of these parts is marked on most microscopes.

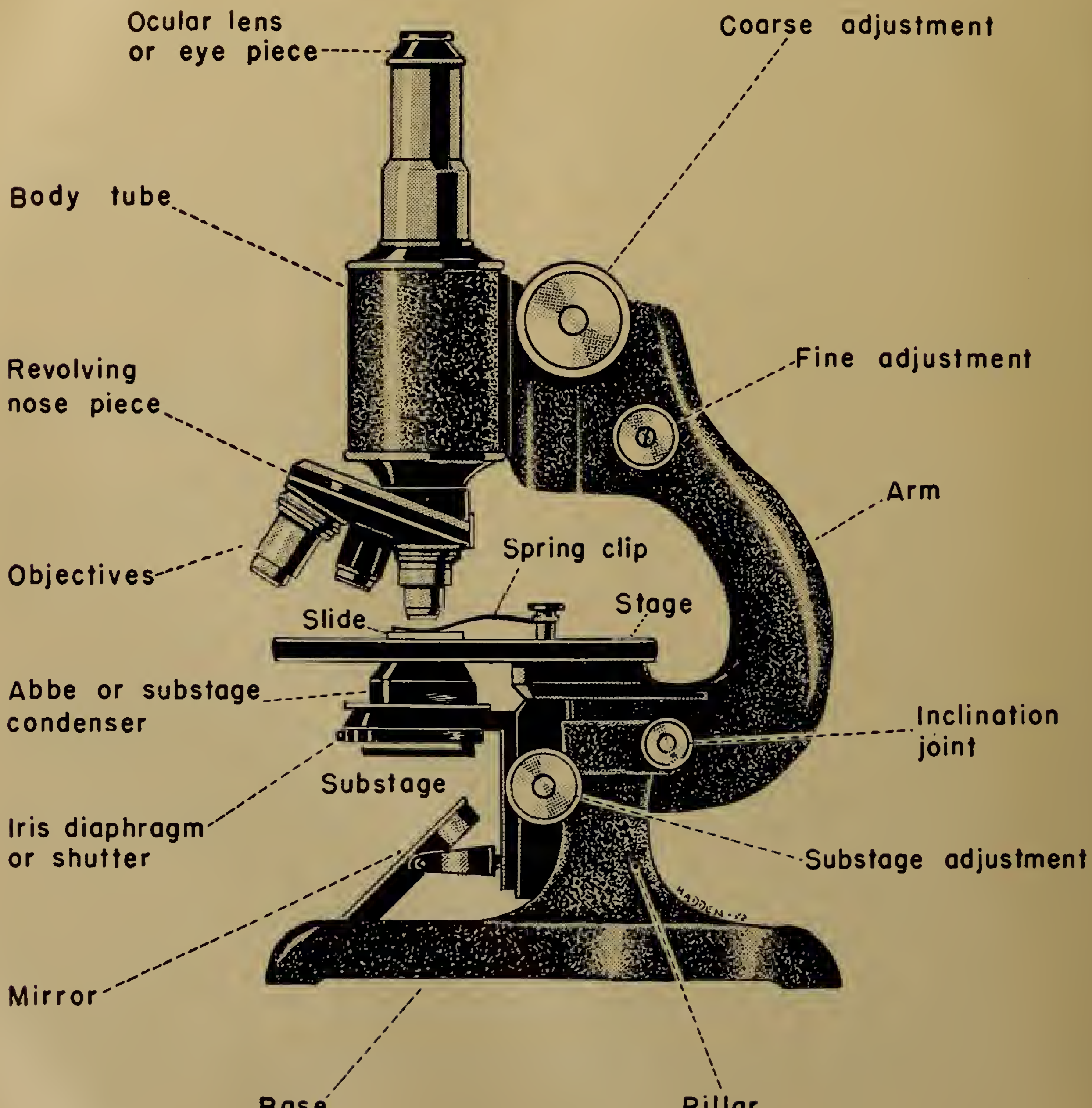


Figure 380.—The Microscope.

Practical Points in the Use of the Microscope

1. The low power, 16 mm. objective is used in locating fields on stained films and in examinations of liquid material, such as urine and in making "white blood counts."

2. The high power, 4 mm. objective is used in confirming findings of the low power objective; studying live bacterial suspensions for motility, etc.; and in making "red blood counts."

3. The oil-immersion, 1.9 mm. objective is used on stained preparations, using a drop of cedarwood, or other approved oil.

4. The iris diaphragm governs the amount of light required. As a general rule the diaphragm is completely closed when observing liquid preparations with the low power objective, opened slightly when observing liquid preparations with the high power objective. When observing stained preparations with the oil-immersion objective, using natural light, the diaphragm is usually opened wide. The proper amount of light to use depends upon the individual, the type of light used, whether natural or artificial, and the kind of preparation under observation.

5. Generally the concave side of the mirror is used with artificial light, the plane side with natural light.

6. When the preparation to be observed is mounted on the stage, the objective to be used is turned into line with the eyepiece. Lower the head until the eye is on a level with the preparation. Then using the coarse adjustment, lower the objective until it is below the range where it will be used. Then with the eye looking through the eyepiece, raise the objective very slowly, using the coarse adjustment, until the field comes into view, then adjust to the best image using the fine adjustment. **Never lower an objective to find a field while looking through the eyepiece.**

7. On most microscopes, the rotating nosepiece is trifocal, that is, after a field is found with the low power objective, the high power objective can be turned and in focus, requiring only the use of the fine adjustment to bring the image into clear focus. This is especially useful when observing liquid preparations with low power objective and desire to change to the high power objective to aid in identifying an object with greater magnification.

8. All preparations should be examined first with the low power objective to select suitable fields for further examination and study.

9. Both eyes should remain open when using the monocular microscope. This aids in preventing eyestrain. Very little practice is required to do this with ease.

10. After using the oil-immersion objective, wipe the lens carefully with lens paper moistened with a drop of xylol, then wipe with dry lens paper. Occasionally dirty lenses on objectives and eyepieces may have to be cleaned with xylol. Always wipe the xylol off with clean dry lens paper. Never use anything to clean lenses of objectives or eyepieces except lens paper and a little xylol when necessary.

11. Always keep the microscope covered when not in use.

Darkfield examinations are made by the use of special attachments for the microscope. The darkfield condenser replaces the usual condenser, and a funnel stop is placed in the oil-immersion objective. The refractile ring on the darkfield condenser must be centered by careful manipulation of the set screws while observing the ring through the low power objective.

The centrifuge is frequently used in the laboratory. It is used to concentrate sediment in specimens for microscopic examination and also for separating blood serum from the blood cells. Many other uses are found for the centrifuge in the laboratory, and it is necessary to use it properly to insure its satisfactory operation.

A centrifuge is a carefully balanced machine, and its head is attached to the top of its drive shaft; therefore it is important to keep it balanced. If it is not kept in balance, centrifuge tubes are likely to be broken, and important specimens will be lost. When placing specimens in the centrifuge, make sure that fluid levels in opposite tubes are at the same level. When only one specimen is being centrifuged, place another tube on the opposing side with an equal amount of water for a balance tube.

HOW BACTERIA ARE CLASSIFIED

Staining

Many bacteria are differentiated from other organisms by staining. For general bacteriological

work, basic stains (i. e., compounds of color bases) are used because bacteria react toward stains as though composed principally of nucleic acid, which takes basic dyes most readily. Thus methylene blue, safranin, crystal violet (gentian violet), basic fuchsin, eosin, etc., are generally used. All belong to the group of aniline (coal tar) dyes. Bacteria, when stained, become visible under the microscope, and can be more accurately described.

Morphology (Shape)

There are two main forms of bacteria, spherical and cylindrical.

Spherical bacteria are called cocci, and these are classified by the manner in which they cling.

Diplococci occur in pairs.

Streptococci cling together in chains, looking much like a string of beads.

Staphylococci occur in groups shaped like bunches of grapes (fig. 381).

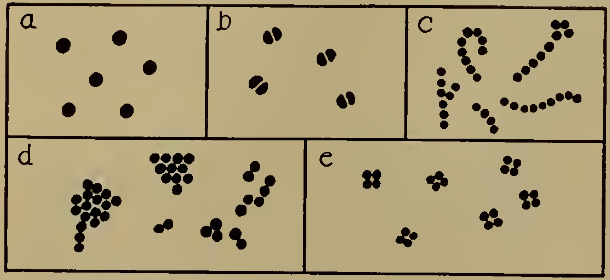


Figure 381.—Various Types of Cocci—a–Single Cocci—b–Diplococci—c–Cocci in Chains—d–Cocci in Clusters—e–Cocci in Tetrad—

Cylindrical bacteria are of two main types: straight, rodlike forms bacilli (fig. 382); and curved or spirally twisted types, of which there

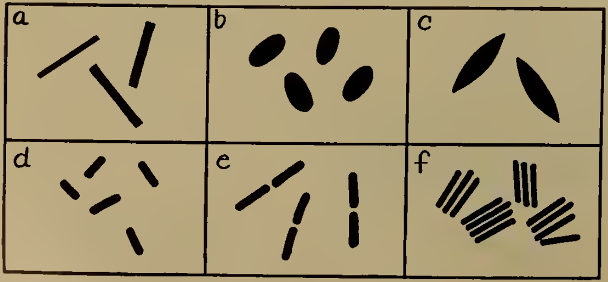


Figure 382.—Various Types of Bacilli—a–Bacilli with Square Ends — b–Coccobacilli — c–Fusiform Bacilli — d–Bacilli with Rounded Ends—e–Diplobacilli—f–Bacilli in Parallel Formation—

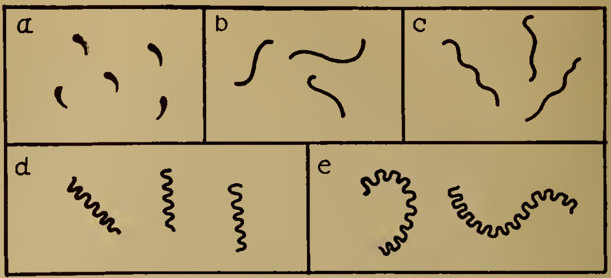


Figure 383.—Various Types of Spirilla: a–Vibrio—b–Spirilla—c–Borrelia—d–Treponema—e–Leptospira—

are three principal subdivisions as follows: Those which are much like bacilli in shape but merely curved are placed in a genus called Vibrio (fig. 383); those which are spirals of one or more complete turns and which are rigid, like a twisted stick of wood, are placed in the genus Spirillum (fig. 383); those which likewise are spirally twisted but which are also flexible, like a piece of thin, coiled wire, are referred to as Spirochaetes (fig. 383). The relations of the morphological types may be clarified by the following outline:

Spherical (cocci).
Diplococci (pairs).
Streptococci (chains).
Staphylococci (irregular groups).
Cylindrical.
Bacilli (short, straight rods).
Vibrio (short, curved rods).
Spirillum (spirally twisted, rigid).
Spirochaete (spirally twisted, flexible).

Bacteria are not identified by morphology alone. Many bacteria differ widely in other properties. Bacteria are classified on the basis of biochemical, serological, and pathogenic properties, morphology, physiology, metabolism, chemical composition, and any other distinctive characteristics which may serve as a means of telling them apart.

Bacteria are very small. Their minute size may be emphasized by various comparisons. For example, it is estimated that a cubic inch would hold nine trillion (9,000,000,000,000) medium-sized bacilli. It is common practice to magnify bacteria 1,000 times with a microscope. They may then look no bigger than a period or an exclamation point (!). A man magnified to the same degree would be over a mile high and 500 yards wide.

Cultural Characteristics

To combat harmful bacteria one must know how they grow and their needs.

Temperature.—Most bacteria in an actively growing (vegetative) state are readily killed by exposure to temperatures of around 70° C. Many species of bacteria in the soil, water, air, and body grow well at 25° to 40° C. (Human body temperature is 37° C.). Several species of bacteria thrive only at high temperatures (60° to 80° C.). Many bacteria can live for months in a dormant state, at freezing temperature.

Acid or Alkali (pH).—Concentration of acid or alkali of the bacterial fluid affects their growth.

Oxygen.—Some bacteria require air to grow while others do not. Bacteria that grow best with reduced oxygen are known as anaerobic organisms, while those that grow best in the presence of oxygen are known as aerobic.

Bacteria will live and grow better if they are subjected to their own type of food, temperature, and hydrogen ion concentration (pH). Therefore pathogenic bacteria would require culture media and temperature controls similar to that of the human body. We create an artificial medium called media and grow the organisms under proper temperature control. Bacteria growing on these media will provide different characteristics, such as a colony size, color, and character of margin. Both culture media are used chiefly for motility tests. Final determination of the identity of many organisms depends upon whether or not they produce acid or gas or neither one of the two when cultured in the various carbohydrates. There are many special culture methods for identifying specific types of organisms.

Pathogenicity for Animals

Animal inoculation is of great value as a means of identifying many pathogenic organisms. The susceptibility of a certain species of animal and the type of disease produced are frequently essential in diagnosis; however, this is a procedure adaptable to large laboratories and is not suitable for shipboard use except to a minor degree on hospital ships.

Bacterial Motility

Motility is a definite and important factor and is many times the deciding point in identifying an organism. An organism must have a positive and progressive motility to be considered motile. The organisms apparently cannot control their speed, which always seems to be at a maximum for a given individual bacteria. Their speed is sometimes very great when measured by their size. Some of them cover a distance equal to hundreds of times their length in a second. The motility due to a bacterial action is easily visible upon direct observation of the bacteria in a droplet (hanging drop) of the fluid in which they are living. It is necessary to distinguish carefully between motility and brownian movement. Truly motile bacteria progress definitely and continuously in a given direction. Brownian movement is a back-and-forth movement. It is due to molecular forces entirely external to the bacteria. Unless the bacteria are fairly active, brownian movement is sometimes rather difficult to distinguish from true motility.

Filtrable viruses are organisms so minute that they will pass through the pores of a porcelain filter. They cause the following diseases: Smallpox, varicella, lymphogranuloma inguinale, foot and mouth disease, herpes febrilis, epidemic encephalitis, poliomyelitis, rabies, benign lymphocytic choriomeningitis, influenza, common cold, measles, mumps, dengue, yellow fever, and sandfly fever.

STAINING OF BACTERIA

Preparation of Smears for Staining

Smears are thin spreads of pus, blood or bacteria on a glass slide or cover slip. They may be made from material from the throat, sputum or abscesses.

The first essential for a proper bacteriological examination is a good smear. Glass slides and cover slips must be clean and grease free. The smear must be thin to permit good staining and observation.

Usually a platinum loop or a sterile cotton swab is used in making smears. The loop is made sterile by heating in an open flame of a bunsen burner or an alcohol lamp. It must be permitted to cool for a few seconds. Thick material may require dilution with sterile distilled water. Place drop of water on slide, then a loop full of the material to be examined is rubbed well with the

water, spreading over a fairly large area. If the bacteria are in fluid media, the water is not needed.

For examination of pus use a cotton swab or a loop and spread out just enough of the material to make a visible film on the slide. Smears of sputum should be made from fresh material—recently coughed up from the lungs, as free of mouth secretions or saliva as possible, and collected in a clean container. For the smear select a thick lump of mucus and avoid the frothy, watery saliva.

Smears are allowed to dry in the air and then are fixed to the slide by passing through a flame two or three times. One can learn to judge the proper temperature by touching the glass to the back of the hand at intervals. If the film takes on a brownish discoloration, it has been scorched and is worthless.

Blood smears should not be fixed by such heating.—The smear then is ready for staining with whatever dye is indicated, Gram's method being the best routine process for most bacteria, except the tubercle bacillus, which requires the acid-fast staining method.

Gram's Stain

Differential stains are those in which a basic and counter stains are used for the purpose of differentiation. The classic example of a differential stain is the Gram stain. Organisms stained by this method either retain the crystal violet of the basic stain and are known as Gram-positive or retain the red or pink of the counter stain and are known as Gram-negative. The Gram stain is applicable both to culture material as well as smears from pus or other pathologic material.

Gram Stain Technique

Flood slide with crystal violet (gentian violet) for 2 minutes.

Rinse with tap water.

Flood slide with Gram's iodine for 2 minutes.

Rinse with tap water.

Decolorize by rinsing smear with acetone-alcohol mixture until the purple stops streaming from smear.

Rinse with tap water.

Counter stain with safranin for 1 minute.

Rinse with tap water.

Dry in the air or by warming above the microscope lamp.

Examine under oil immersion.

Gram's Stain Report

Assuming the patient has a history of unprotected sexual exposure, a purulent urethral discharge smear should be sent to the laboratory with a request for Gram's stain examination. When the slide is examined under oil immersion, an acute case of gonorrhea will present the following picture:

Numerous pus cells. Some mucus. Many Gram-negative intracellular and extracellular diplococci morphologically resembling N. gonococci. For typical illustration see plate No. III.

In any Gram's stain, all organisms noted should be given on the report according to their shape and staining reaction.

Gram's Staining Solutions

Gentian violet.

Solution No. 1

Crystal or gentian violet—2 gm.
Aniline oil—9 cc.
Alcohol 95 percent—33 cc.

Solution No. 2

Crystal or gentian violet—2 gm.
Distilled water—100 cc.

These stock solutions keep indefinitely. To prepare the working solutions mix 1 cc. of No. 1 with 9 cc. of No. 2 solution and filter. This solution will keep about 2 weeks.

Gram's Iodine

Iodine—1 gm.
Potassium iodide—2 gm.
Distilled water—300 cc.

(This is made by dissolving KI in a few cc. of distilled H_2O and then adding I and dissolving. Then q. s. with distilled H_2O.)

Acetone and alcohol—(Decolorizing agent).—Equal parts of acetone and ethyl alcohol 95 percent.

Safranin.—Safranin is made by mixing 10 cc. of a saturated alcoholic solution of water soluble safranin with 90 cc. of distilled water. This solution keeps indefinitely. For illustration of Gram-positive streptococci see plate No. IV.

Acid-fast staining method—(Ziehl Neelsen).—This is another differential stain used especially

for staining tuberculosis bacilli in sputum and is applicable to all organisms having chemical composition peculiar to these bacilli and closely related species. Among these are leprosy, smegma, butter, grass bacilli and a bacillus found in old distilled water. For this reason old distilled water should not be used in medications, rinsing X-ray films, or for making staining solutions.

Acid-Fast Stain Technique

The only acid-fast bacillus likely to cause confusion is the smegma bacillus which occurs normally about the genitals and other parts of the body. Acid-fast bacilli found in the bladder specimens should be further studied before being identified. Since all of these organisms fall into a closely related species, we can say that they are all characterized by an abundance of waxy material in the cell or body of the bacteria. As a result of this waxy composition, when ordinary dyes like methylene blue are applied, they fail to penetrate the wax and the bacilli remain unstained. By Gram's method they are stained purple, but this method does not give as much information about them as the Ziehl-Neelsen or acid-fast stain. In using this stain a smear of the material to be examined is made as usual, dried, and fixed by heat. Then stain as follows:

Apply carbol fuchsin stain solution and steam gently for 3 to 5 minutes, pass Bunsen burner under slide very carefully one or two times until steam appears. You may also cold stain for 15 minutes. This will serve the same purpose.

Wash with tap water.

Decolorize with 5 percent hydrochloric acid (HCl) alcohol solution until the red color stops streaming and only a suggestion of pink remains.

Wash with water.

Counterstain with Löffler's methylene blue for 1 to 2 minutes.

Wash with tap water.

Dry in the air or by warming above the microscope lamp.

Examine under oil immersion.

The tubercle bacilli stand out as bright red bacilli in a blue field. The Zieh-Neelsen stain is a differential stain because it differentiates acid-fast organisms from nonacid-fast ones. In reporting results of acid-fast stain it should be reported as positive or negative for A. F. B., giving approximate number of bacilli per field or fields. See plate No. V.

Staining Solutions

Carbol fuchsin is prepared by taking 10 cc. of a saturated solution (alcoholic) of basic fuchsin (3 gm. per 100 cc.) and adding 100 cc. of a 5 percent solution of phenol.

Löffler's methylene blue is prepared by taking 30 cc. of a saturated solution (alcoholic) of methylene blue (7 gm. per 100 cc.) and adding 100 cc. of a 1:10,000 aqueous solution of potassium hydroxide.

Corynebacterium Diphtheriae — Diphtheria Bacilli

These are slender, sometimes slightly curved rods, usually with slender bodies showing dots at each end in stained preparations. They are gram-positive and nonmotile. In examinations for these organisms special types of stains aid greatly in identification. When diphtheria infection of the throat is suspected, the following procedure should be carried out:

1. With sterile cotton swab, material from the suspected site in the throat is picked up and rubbed onto a glass slide.
2. Permit to air dry, then fix with heat as any smear.
3. Stain with Beck's stain as follows: Flood area with solution A for 2 minutes.
4. Wash with water.
5. Flood area with solution B for 30 seconds.
6. Wash with water, dry and mount on microscope, using drop of oil and oil-immersion lens. If diphtheria bacilli are present, they will appear as in plate No. VI.

Beck's Staining Solutions

Solution A.—Saturated alcoholic solution Crystal Violet, 10 cc.; acetic acid (4.3 percent aqueous solution), 90 cc.

Solution B.—Bismark Brown, 0.48 gm.; Distilled Water, 125 cc.

In examinations for diphtheria bacilli, cultures for these organisms should be made. This requires special types of media and special equipment. Consult standard laboratory manuals or texts for this procedure.

Borrelia Vincenti and Fusiform Bacilli

These organisms are the causative agents of the infection known as Vincent's angina or Vincent's infection. They are associated usually with ulcerative conditions of the throat, of gums, or both. The Borrelia is a slender spiral, with regular undulations. The Fusiform bacillus is a coarse, rather plump rod form, which may be straight or slightly curved.

When making smears from a suspected throat, the following procedure should be used:

1. With sterile cotton swab, material from suspected ulcerations or in the throat is picked up and rubbed on a glass slide. (If smears from the gums are made, a sterile platinum loop may be preferable.)
2. Permit to air dry, then fix with heat as any smear.
3. Stain with any of the simple stains; safranin, methylene blue, or dilute carbol fuchsin for 1 to 2 minutes.
4. Wash with water, dry and mount on microscope, using a drop of oil and the oil-immersion lens. If positive for Vincent's infection it will appear similar to plate No. VII.

Dilute carbol fuchsin is made by diluting the carbol fuchsin used in the acid-fast stain.—10 cc. of the stain diluted to 100 cc. with distilled water.

DARKFIELD EXAMINATIONS

The darkfield examination is a test employed to assist in the identification of *Treponema pallidum*, the cause of syphilis. It is found in primary, secondary, and tertiary lesions, but it is not present in the last stage in sufficient numbers to be of value in diagnosis. Other organisms may be seen in the darkfield preparation; but as they are stained easily, this method is not employed. There are a number of spiral-shaped organisms that occur in ulcerative lesions, and so great care must be exercised in making a positive report of *Treponema pallidum.*

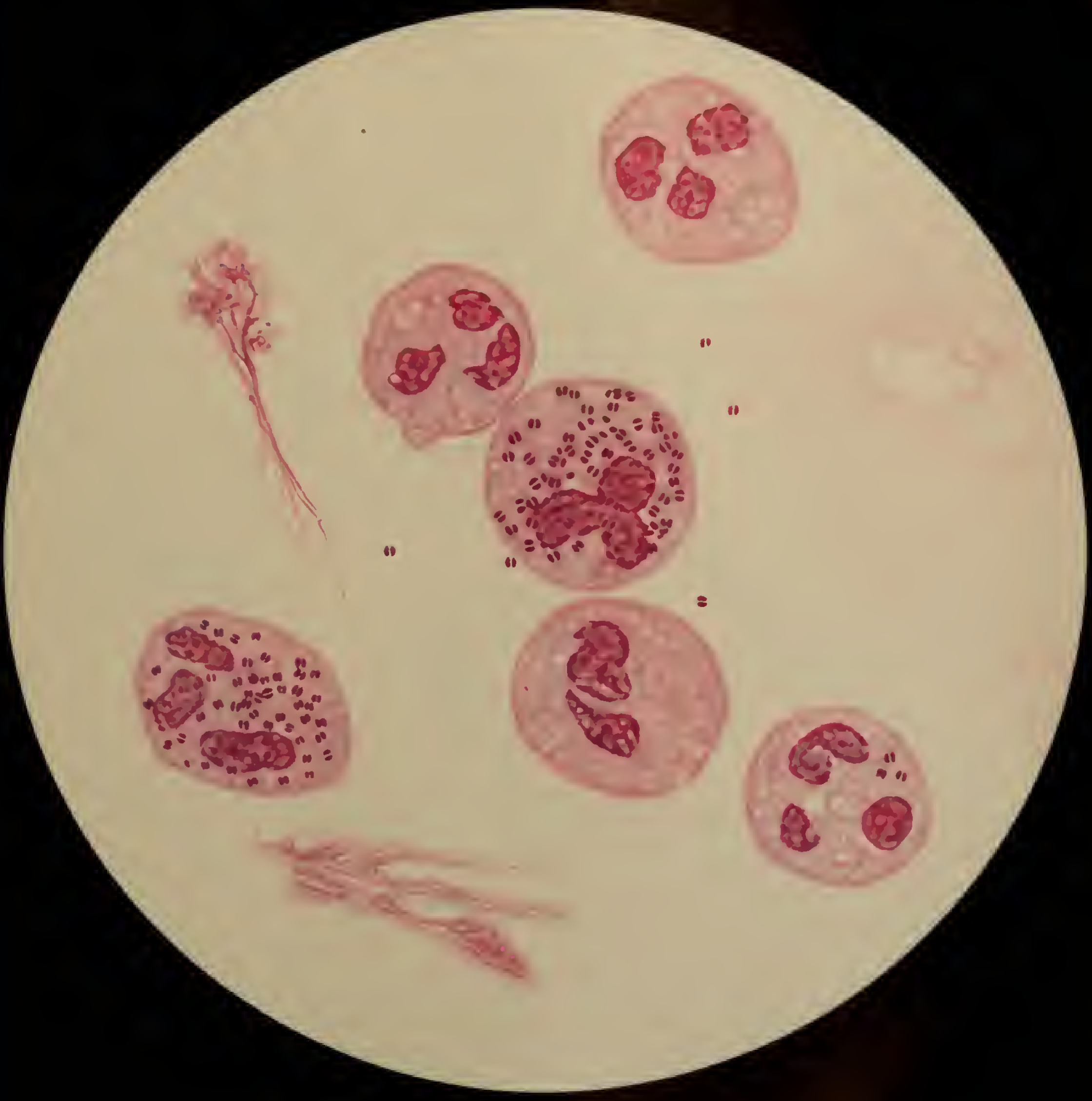
Form of T. Pallidum

Treponema pallidum is an extremely slender, spiral, motile thread with pointed ends. The organisms vary considerably in length, the average being about 10 to 12 microns, or somewhat greater than the diameter of a red corpuscle, and it exhibits 5 to 12, sometimes more, spiral curves, which are sharp and regular and resemble the curves of a corkscrew. As seen in fresh material by darkfield illumination it moves relatively slowly forward, rotating on its long axis and retaining its regular curves. It takes up stain so poorly and is so delicate that it is difficult to see even in well-stained preparations; a high magnification and careful focusing are, therefore, required. Upon ulcerated surfaces it is often mingled with other spiral microorganisms, a fact which adds to the difficulty of its detection. The most notable of these is Borrelia refringens. *Treponema pallidum* is most easily demonstrated in chancres and mucous patches, although the skin lesions, papules, pustules, etc., often contain large numbers. Tissue juice from the deeper portions of the lesions is the most favorable material for examination because the organisms are commonly more abundant than upon ulcerated surfaces and are rarely accompanied by other microorganisms.

Darkfield Technique

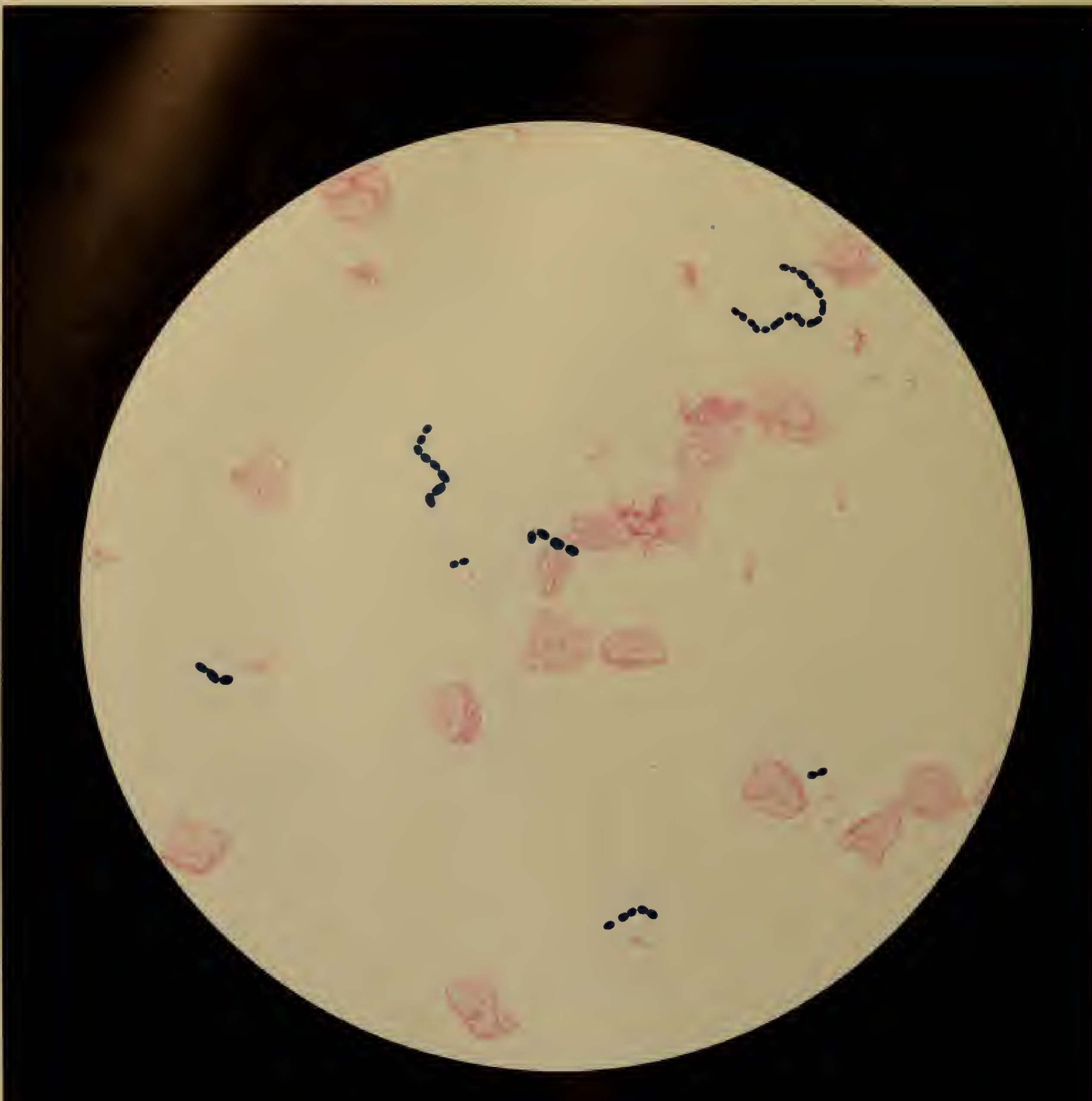
Microscope and illumination.—Of the many reasons for failure with the darkfield technique the most common is unsatisfactory lighting. A powerful source of light is essential. Direct sunlight, the arc-light, or a lamp capable of giving a point source of light of high brilliancy should be used. In emergencies, a strong focusing flashlight (three cells or more) may also be employed. Since the special darkfield illuminators (condensers) are designed for parallel beams of light, a parallelizing system should be employed with artificial light and the light then reflected into the condenser with the plane mirror of the microscope. The parallel beams of direct sunlight are also directed into the condenser with the plane mirror. If the sunlight is too brilliant, one or more pieces of ground glass may be used between the sun and the mirror.

The preparation under examination should be protected from the direct rays of the sun. If a lamp is used without a ground daylight glass or a parallelizing lens, one may get better results with the concave mirror, which tends to make the rays from the lamp more perfectly parallel. If the light is not sufficiently strong, better results may be obtained by using the concave mirror even though there be some reduction in definition.

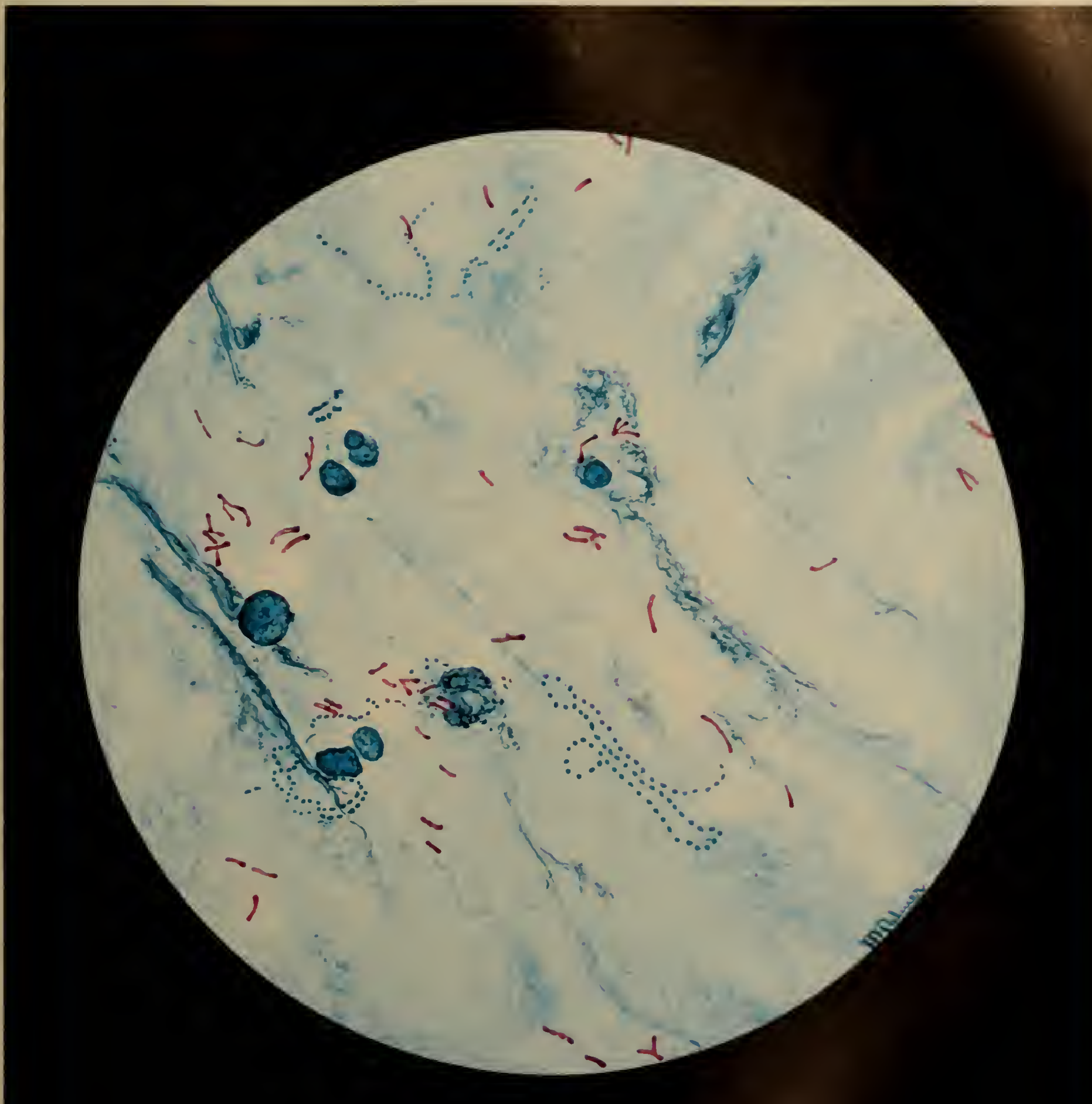


GONOCOCCI

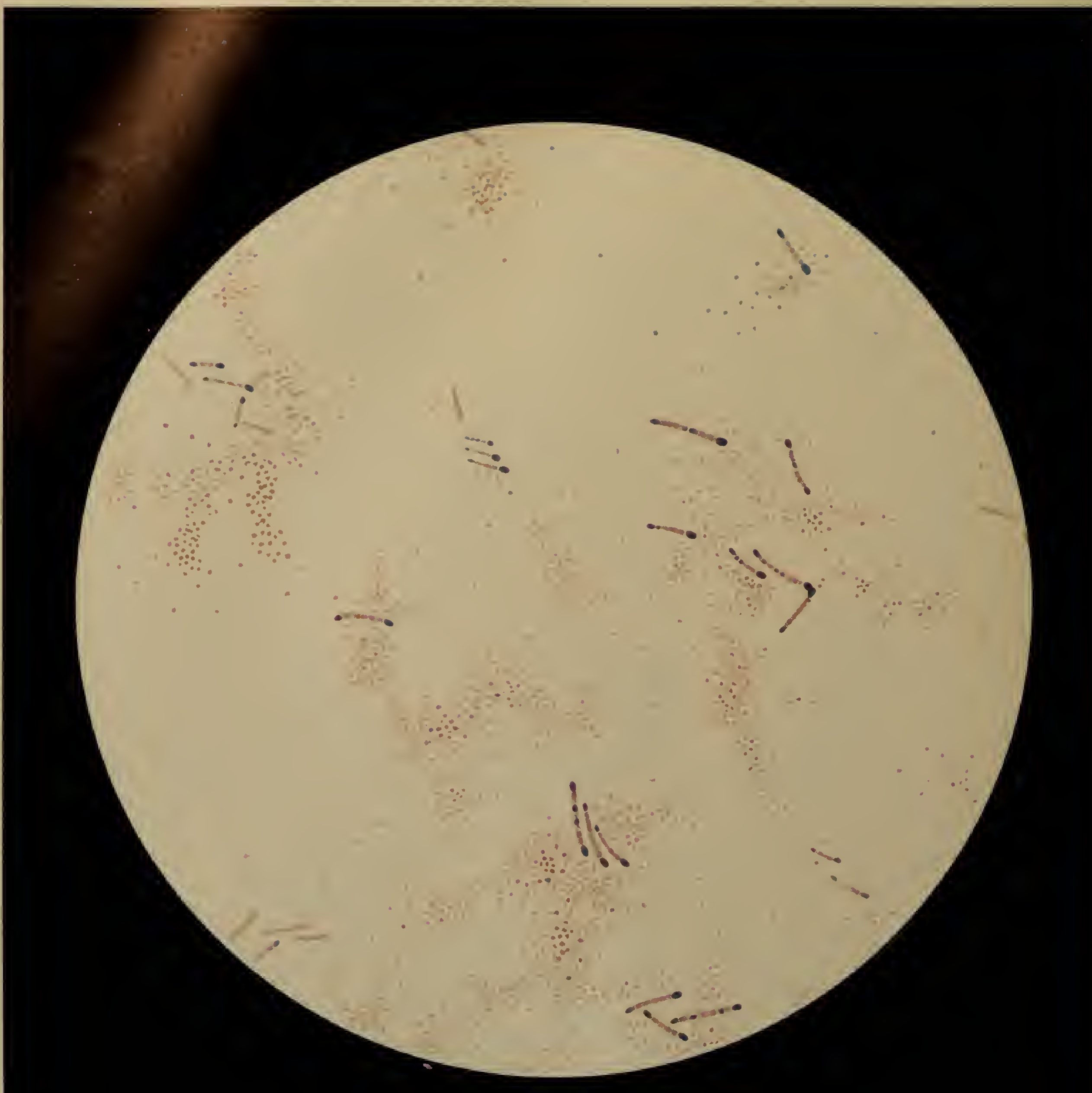
(Gram stain urethral discharge)



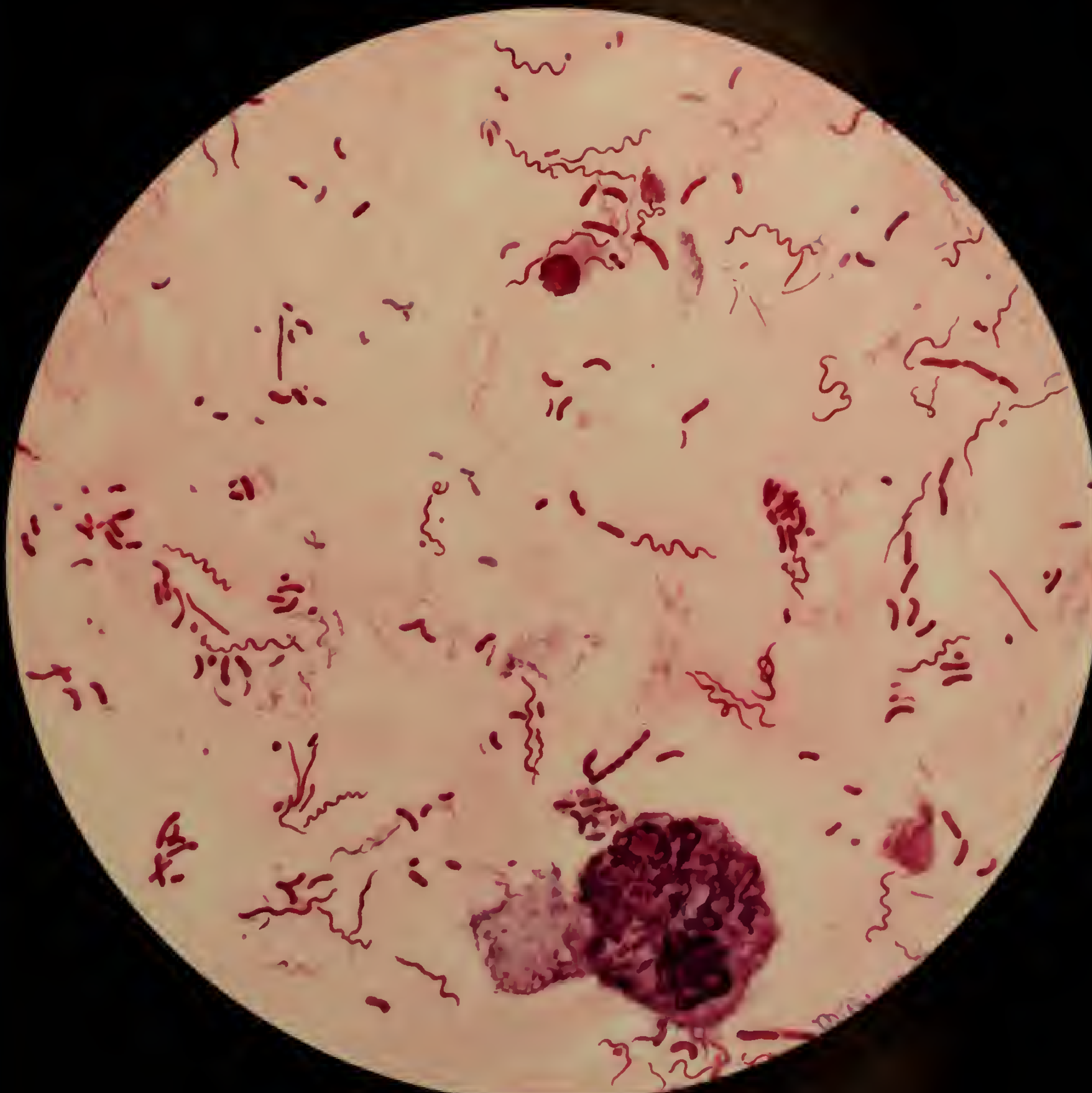
HEMOLYTIC STREPTOCOCCI
(Gram stain from blood culture flask)



MYCOBACTERIUM Tb



CORYNEBACTERIUM DIPHTHERIAE
(Beck's stain)



BORRELIA VINCENTI
& FUSIFORM

Remove the Abbe condenser and fasten the clean paraboloid or cardioid illuminator (condenser) in its place. It is necessary that the upper lens surface be clean and that it be possible to bring it into the plane of the upper surface of the stage or a little higher. Direct a strong beam of light (parallel rays if possible) on to the plane mirror. Reflect the light into the illuminator.

Before placing the preparation to be studied on the stage, focus the low power objective on the upper surface of the illuminator lens. A small circle which is scratched on this surface will be seen. This circle represents the center of the lens and must be brought into the exact center of the field by means of the centering screws on the illuminator.

Preparation of specimen.—After cleansing the area of foreign material, gently scrape the surface with a curet or rub briskly with a swab of cotton or gauze. In a few moments serum will exude and very thin smears are made. Exudation of serum may be hastened by gentle squeezing. Prior to transferring the serum to the slide and cover slip they must be very carefully cleaned. The cover slip should have white petrolatum placed along the sides. This prevents the serum from leaking out between the slides and infecting the operator. Transfer serum from the lesion to the slide by means of a platinum loop. Flame loop to obtain sterility and reflame after using to kill possible infectious material. Press cover slip down on top side of slide.

A drop of immersion oil is then placed on the apex of the condenser, the slide is placed in position on the stage, and the condenser is raised until the oil is in contact with the under surface of the slide. The low-power objective is now focused on the slide. If the light be sufficiently intense and the mirror properly adjusted, a circle or a spot of light should be seen in the center of the field. A circle indicates that the condenser is decidedly above or below its correct position. The condenser is then focused by raising or lowering it until the circle becomes a spot of light and this spot becomes as small and as bright as it is possible to make it. The low-power objective is finally replaced by the higher power with which the examination is to be made and this is brought to focus and used in the ordinary way.

Good results are usually obtained if:

1. Clean slides and cover glasses of correct thickness are used.
2. The special darkfield condenser is carefully centered. (The top of the condenser should be thoroughly cleaned in order to facilitate the finding of the centering circle.)
3. The top of the condenser and the bottom of the slide are brought into close proximity and then adjustments made to correct for variation in slide thickness by raising or lowering the illuminator.
4. Air bubbles are removed from the oil between the condenser and the slide.
5. A thin rather than a thick preparation is made.
6. The presence of excessive amounts of large elements such as blood cells is avoided.

MISCELLANEOUS BACTERIOLOGICAL TESTS

Agglutination tests.—If the serum of a typhoid fever patient is added to a culture of typhoid bacilli, clumping or agglutination of the bacteria takes place. This is called the Widal reaction. Several other diseases can be diagnosed by agglutination tests; among them are meningitis, tularemia, undulant fever, cholera, paratyphoid fever. This is done by using the patient's serum and the causative organism.

Sensitization tests.—Many people are hypersensitive (allergic) to certain proteins (foods, epidermals, pollens) and suffer from asthma, hay fever, urticaria, etc. Extracts of the proteins when applied as a scratch test or intradermally produce hives in a person sensitive to the particular substance.

Schick test.—Inject intradermally 0.1 cc. of diphtheria toxin. If a reddened area appears within 24 hours and reaches a maximum after 2–3 days, the test is positive and indicates that the individual is lacking in antitoxin and is susceptible to diphtheria.

Dick test.—Scarlet fever toxin is injected intradermally. If the person is susceptible to scarlet fever, a red infiltrated area appears within 24 hours.

Mantoux test.—Tuberculin is injected intradermally. A local reaction indicates past or present tuberculous infection. If a scratch test is used it is called a von Pirquet test.

URINALYSIS

Urine is an excretion formed in the kidneys. Normal constituents of the urine are divided into organic and inorganic groups. The important organic constituents are urea, uric acid, and creatinine; those of the inorganic group are the chlorides, phosphates, sulfates, and ammonia. The normal urine may contain various cellular elements, such as epithelial cells and leukocytes; it may also contain a number of crystals which usually form on standing and which are recognized microscopically.

Normal urine as voided is light straw to dark amber in color, acid in reaction, and transparent. Usually the composition of the urine of a given individual, voided in a 24-hour period, does not vary much from day to day; specimens voided at different times in the day may, however, differ markedly. In qualitative work random specimens may be examined, but a 24-hour specimen is more desirable, and quantitative tests are valueless unless done on the mixed specimen for the 24-hour period. A 24-hour specimen of urine should be collected in a clean container and kept cold (preferably on ice) or protected by a suitable preservative until examined. Toluene is the best preservative as it interferes least with the tests which may be performed. One or two cubic centimeters placed in the container to be used for collection of specimen suffice for this purpose. Thymol also may be used as a urinary preservative. The use of preservatives should not be substituted for refrigeration, cleanliness, and care.

ROUTINE EXAMINATION

Urine for examination should be clear and may be made so by simple filtration or by filtration after the urine has been mixed and shaken with a small amount of purified talc.

When making a routine urine examination one should:

1. **Measure the amount.**—The 24-hour specimen normally should be from 1,000 to 1,500 cc. This amount depends upon the balance between the quantity of fluids ingested and the fluids lost by other avenues—perspiration, respiration, feces (as in diarrhea), and vomitus.

2. **Note the color.**—This varies in health and depends upon the concentration. The presence of blood, bile, urobilin, and some drugs will affect the color. A pale urine of high specific gravity suggests the presence of sugar (diabetes).

3. **Note the transparency.**—Freshly passed urine is usually clear but upon standing becomes cloudy. Large quantities of amorphous phosphates, amorphous urates, pus, blood, and bacteria produce sediments or cloudy appearance.

4. **Note the odor.**—An aromatic odor is due to volatile acids; ammoniacal is due to decomposition; fruity is due to acetone; and characteristic odors are due to certain substances, such as asparagus, etc.

5. **Test for reaction.**—Acid urine turns blue litmus paper red; alkaline urine turns red litmus paper blue. If the urine is neutral in reaction, no apparent change is produced in the litmus papers. Normally urine is acid in reaction, but it soon becomes alkaline upon standing when not refrigerated or preserved.

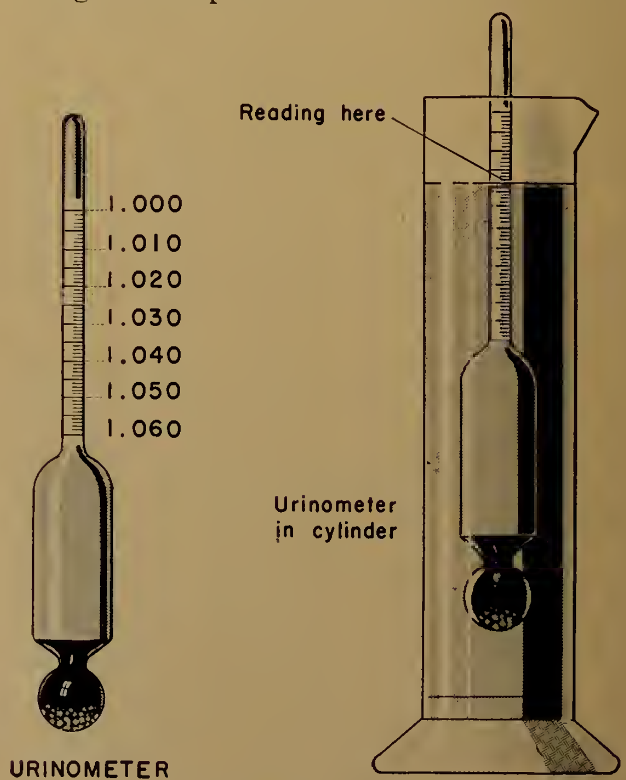


Figure 384.—The Urinometer.

6. **Test to determine specific gravity.**—Normally this is 1.010 to about 1.020. A urinometer is the most convenient means of determining the

specific gravity of urine. A special container is filled with urine and a urinometer is placed in the container. The urinometer should not touch the sides or bottom of the container and should be read at the bottom of the meniscus. The sugar content of urine in diabetes causes a high specific gravity (fig. 384).

7. **Test for albumin,** using the heat and acetic acid test. Fill a clean test tube two-thirds full of clear urine. Filter, if necessary, to clear. Boil the upper portion. Add 3 to 10 drops of 10 percent acetic acid to acidify and reboil. Compare boiled and unboiled portion and report the degree of turbidity of the coagulated albumin on the basis of 4 plus as a maximum. A turbidity in the boiled portion that clears with the acid is ordinarily due to carbonates or phosphates. Albuminuria is an abnormal condition indicating a leakage of blood serum albumin into the urinary tract and requires further careful investigation.

7a. **Test for albumin,** using the sulphosalicylic acid test. Centrifuge the urine and decant 2.5 cc. into a test tube (16×150 mm.) marked at 2.5 cc. and 10 cc. Add 7.5 cc. of 3 percent solution of sulphosalicylic acid. Invert the tube to mix contents. Do not shake. Let stand for ten minutes and observe. A white turbidity indicates the presence of albumin. Report the degree of turbidity on the basis of 4 plus as a maximum.

The sulphosalicylic acid test for albumin in urine may also be employed as a quantitative procedure. The same procedure is followed as under the qualitative test, except that the turbidity is compared with permanent standards. The results are then reported either in percentage of albumin or in milligrams per 100 cc. of urine, ranging from 10 to 100 milligrams.

8. **Test for glucose** (sugar) by placing 5 cc. of Benedict's qualitative solution in a test tube. Boil. Add 0.5 cc. of urine. Boil 2 minutes and let cool. If glucose is present, the blue cupric salt will be reduced to a cuprous salt and the solution will be filled with a green, yellow, or red precipitate. Report on the basis of 4 plus as the maximum red precipitate. Benedict's qualitative solution for urine sugar test is prepared by dissolving 173 gm. of sodium citrate and 100 gm. of anhydrous (or 200 gm. of crystalline) sodium carbonate in 700 cc. of hot water and filter. Add slowly and with constant stirring 17.3 gm. of copper sulfate dissolved in about 100 cc. water. Cool and dilute to 1 liter.

Benedict's quantitative solution is used when required to calculate the amount of glucose present. (See any standard laboratory textbook for preparation of this solution and procedure.)

An occasional trace of sugar in the urine may be an unimportant finding and may occur following general anesthesia, the administration of certain drugs, in pregnancy, in head injuries, or a meal heavy in carbohydrates. The finding of sugar, however, always warrants carefully repeated examinations and if persistent, carbohydrate tolerance should be tested.

9. **Examine microscopically.**—The uncentrifuged urine may be examined microscopically, especially if allowed to stand and some of the sediment taken up in a pipette, but it is usually preferable to centrifuge the urine and examine the sediment. The casts, pus cells, red blood cells, crystals, and other formed bodies, which may be present in a quantity of urine are, by centrifuging, concentrated and more easily found. The sediment may be examined microscopically, either uncovered or covered with a cover glass. In acid urine may be found uric-acid crystals, amorphous urate deposits, calcium-oxalate crystals, and rarely leucine, tyrosine, and cystine crystals, and fat globules; in alkaline urine may be found amorphous phosphates, calcium-carbonate deposits, and ammonium-urate crystals.

The following organized structures may be found in urinary sediments: tube casts, epithelial cells, bacteria, red and white blood cells, spermatozoa, and animal parasites. Pus cells and red blood cells, when present, are reported as the number per high-power field in uncentrifuged urine, using a cover glass preparation. As the urine ages, and also in alkaline urine, the casts and red blood cells decrease in number.

HEMATOLOGY

Counting Blood Cells

Complete Blood Count

This includes the determination of the number of red and white cells in 1 cubic millimeter of blood, the percentage of hemoglobin, and a differ-

ential count which determines the percentage of each type of white cells present. Cells are so numerous in the blood that it must be diluted to separate them and permit the counting of individual cells. The dilution is accomplished in special pipettes (marked 101 for red count and 11 for white count), by first taking up blood and then the proper diluting fluid. The pipettes are so graduated that known dilutions may be made. One part of blood to 200 parts of fluid gives a dilution of 1–200 for the red pipette and 1–20 for the white. The pipettes must be clean and dry before use; this is accomplished by washing out with water, sucking alcohol through to wash out the water, then ether to take out alcohol, and then air to evaporate the ether. The bulb of the pipette or mixing chamber contains a glass bead to aid in thoroughly mixing the diluted blood; and if cleaned properly, the bead will not stick to the sides of the bulb. Plate No. VIII illustrates methods for taking blood from the fingertip for blood counts and smears, use of cover slips and glass slides, and the red and white counting pipette.

Red Blood Count

Cleanse fingertip with alcohol; let it dry. Puncture with sterile needle. Draw blood to exactly 0.5 mark; wipe off tip. See that the blood column reaches from the tip to mark. Draw up diluting fluid (Hayem's) to 101 mark. Cover ends of pipette with thumb and finger and shake vigorously to thoroughly mix. Blow out two or three drops and discard; then apply a drop to the top of the ruled platform of the counting chamber of the hemacytometer at the edge of the cover slip and allow enough of the diluted blood to run in by capillary attraction to fill the space beneath the cover. This space is 0.1 mm. deep. Allow erythrocytes to settle and using the high dry objective, find the large center square which is divided into 400 small squares. Count the number of red cells in 80 of these squares and add four ciphers for the correct red blood count. A normal red blood count is 4.5 to 5 million per cubic millimeter. Hayem's solution consists of bichloride of mercury 0.5 gm., sodium sulfate 5 gm., sodium chloride 1 gm. distilled water 200 cc. (Fig. 385

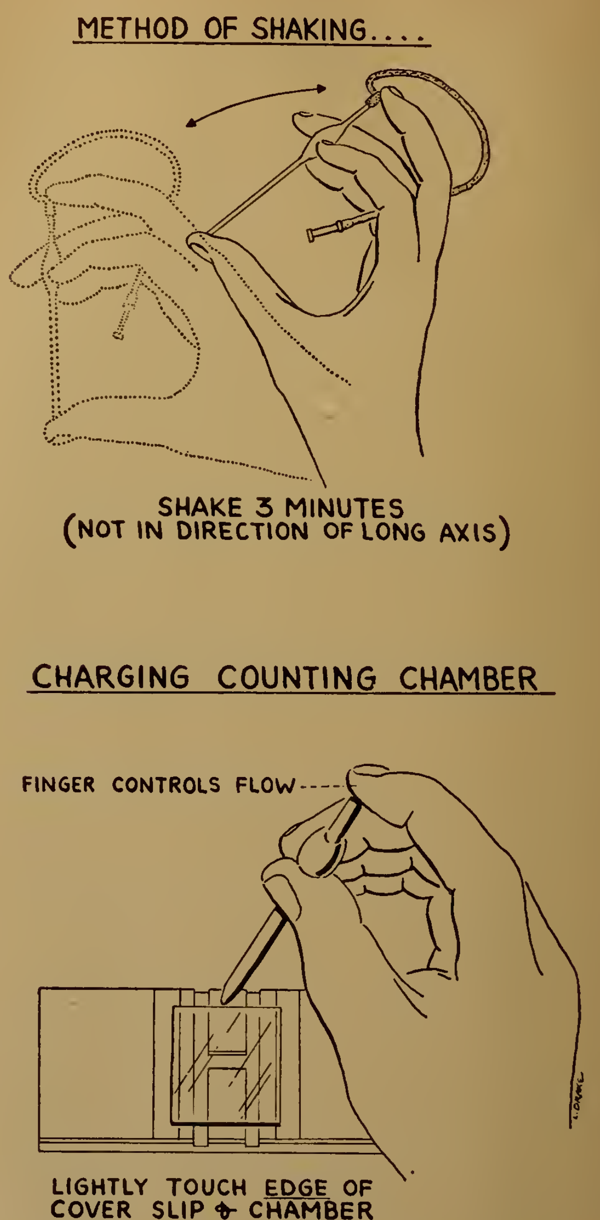


Figure 385.—Method of Shaking Blood Counting Pipette and Charging Counting Chamber.

illustrates a method for agitation of blood counting pipettes and of filling the counting chamber from the pipette. Fig. 386 illustrates the sections of the counting chamber to be used in making the white blood cell count. Fig. 387 illustrates the sections of the counting chamber to be used in making the red blood cell count. It must be remembered that only one section showing sixteen squares can be seen at one time under the low power objective.)

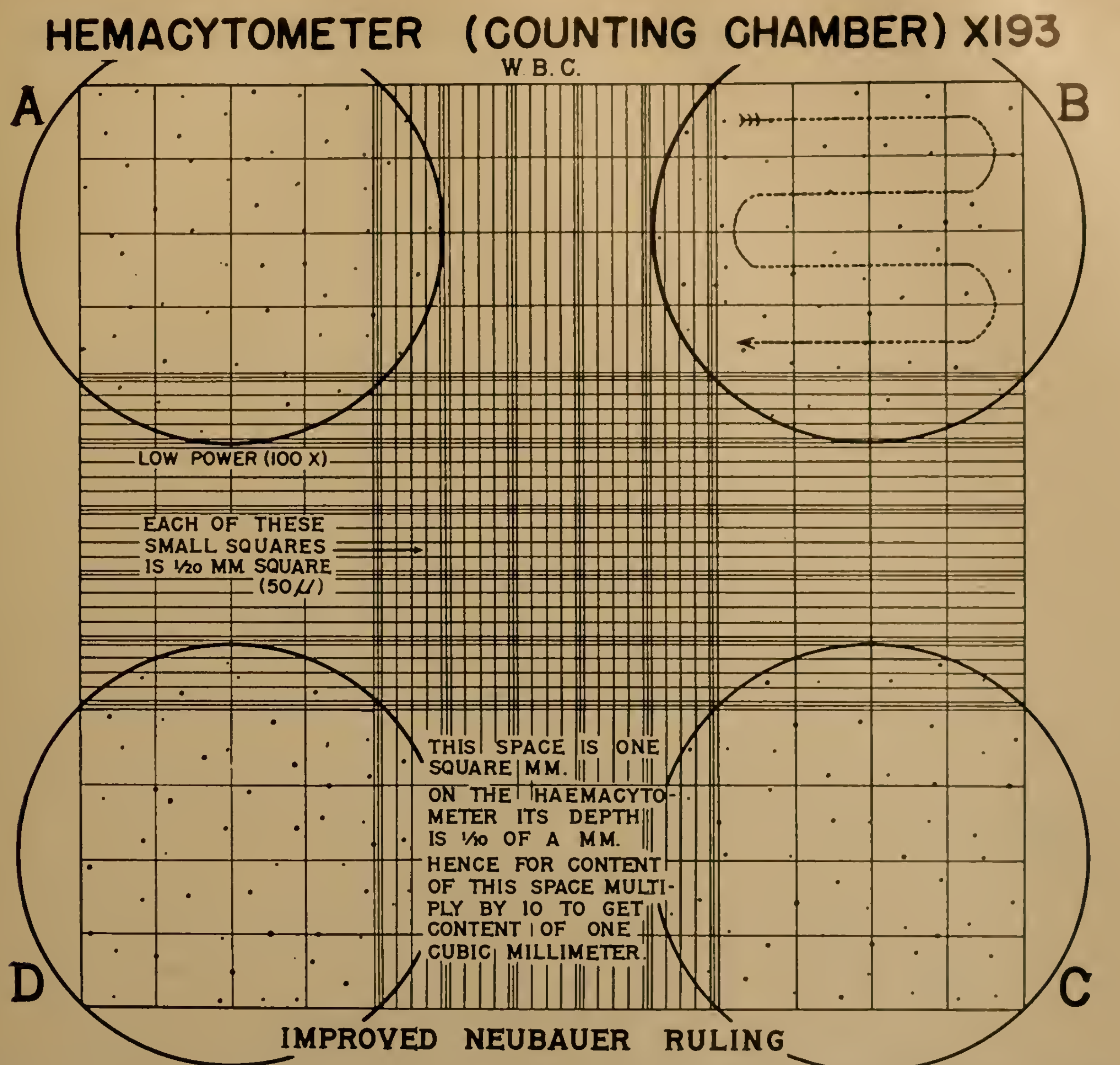


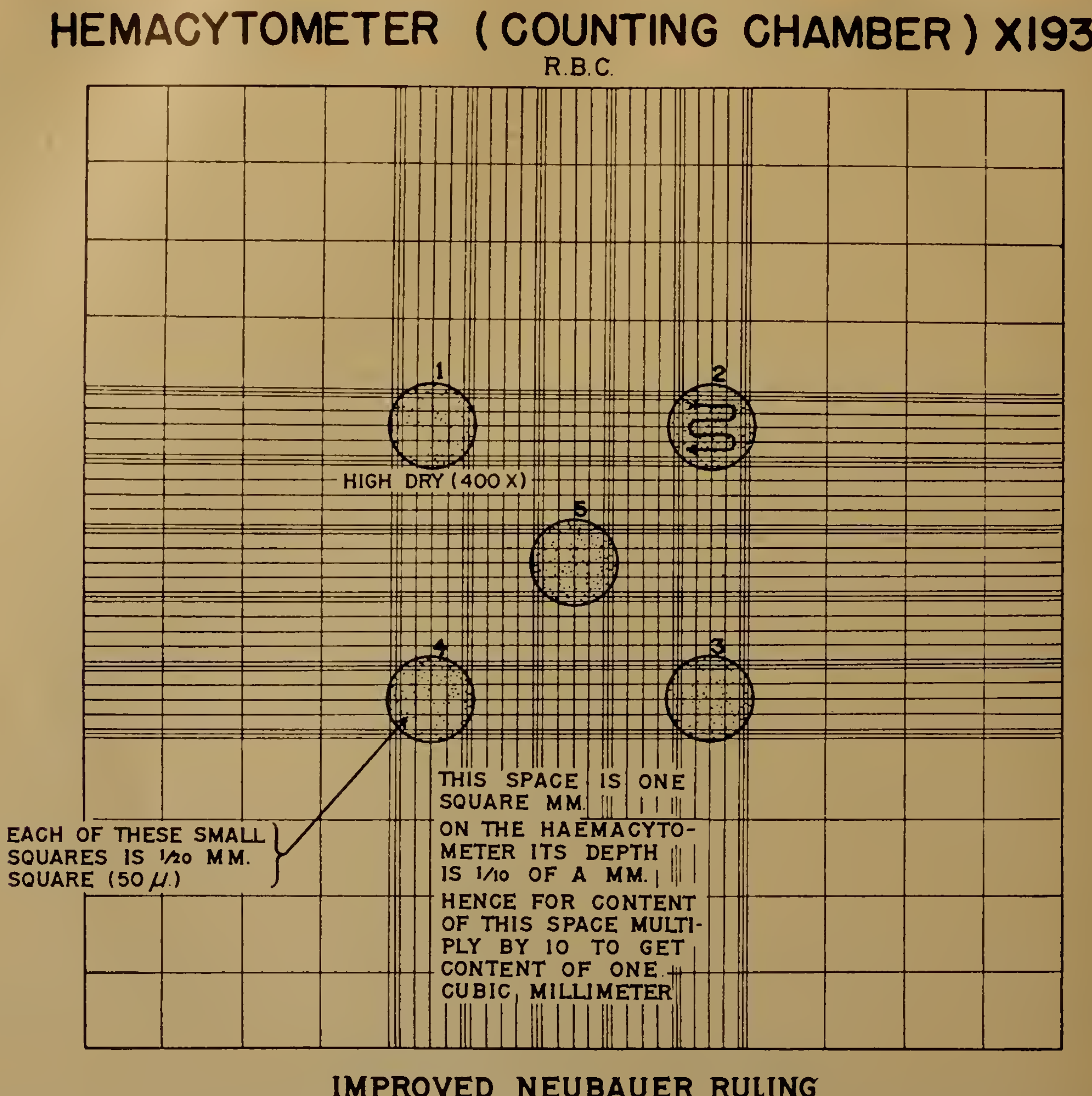
Figure 386.—Sections of Counting Chamber Used in Maging White Cell Count. A, B, C, D illustrates each section as it appears mounted on the microscope.

White Blood Count

Draw blood to 0.5 mark and diluting fluid (3 percent acetic acid or tenth normal hydrochloric acid) to the 11 mark. Mix and blow out two drops. Fill the counting chamber. Allow to settle and count the leukocytes under low power in those square millimeters at each of the 4 corners of the Neubauer ruled areas and multiply the total by 50. A normal white blood count is 5 to 10 thousand per cubic millimeter of blood. A count below 5,000 is called a leukopenia and above 10,000 a leukocytosis.

Differential Count

This is made on a stained smear of undiluted blood. Smears are made on slides or cover slips that are clean and free of all grease. Smears on slides are made by drawing out a drop of blood on one slide by means of the end of another slide. With cover slips, a drop of blood is taken up on the center of one and a second dropped on it. The blood spreads out rapidly in a thin film and then the slips are separated by a sliding motion. Both methods are illustrated. The smears are dried in the air and then stained with Wright's stain. This



IMPROVED NEUBAUER RULING

Figure 387.—Sections of Counting Chamber Used in Making Red Blood Cell Count. 1, 2, 3, 4, 5 are the sections to count, using high power objective.

stain is made by adding 0.3 gm. of the dye to 100 cc. of pure methyl alcohol and put aside for a few days to ripen. To stain, cover blood smear with the stain for 1 minute and then dilute with equal amount of freshly distilled water and allow to stain for 3 to 6 minutes. Wash off, let dry, and examine with the oil-immersion objective, counting 100 cells. The number of each type of white cells then gives the percentage of each. The identification of the various types of leukocytes is best learned by examining many slides with the aid of an experienced technician.

The Schilling classification of leukocytes for differential count and their normal percentage follow: basophiles 0–1, eosinophiles 2–4, myelocytes 0, juveniles 0–1, band forms 3–5, segmented neutrophiles 51–67, lymphocytes 21–35, monocytes 4–8. In severe infectious diseases the number of band and juvenile forms increases at the expense of the segmented neutrophiles and logical cells appear. Among the latter are the myeloblasts and myelocytes of myelogenous leukemia and the lymphoblasts of lymphatic leukemia. Plate No. IX illustrates the development of the blood cell from

the beginning in the various systems to full mature growth. The mature cells are those usually found in differential cell counts. Plate No. X illustrates the complete hematopoietic system and the various functions of the body in the production of blood cells, and the destruction of worn-out blood cells.

The stained smear also is used to demonstrate the presence of malarial parasites, the staining qualities of the red cells and their shape, size, and whether or not any of them show nuclei.

Hemoglobin is the coloring matter of the erythrocytes and is estimated by adding tenth normal hydrochloric acid to blood (which converts hemoglobin to hematin) and comparing the color with the color scales of a Sahli or Haden-Hausser hemoglobinometer. It is reported either in percent of normal or as grams per 100 cc. of blood.

Coagulation and Bleeding Time

Coagulation time of the blood is determined by filling a piece of capillary glass tubing with blood. At half-minute intervals break off a portion. When coagulation has taken place, a wormlike coagulum can be pulled out. Normal coagulation time is 3 to 6 minutes. A long coagulation time is seen in hemophilia and some jaundiced patients.

Sedimentation Rate

Five cc. of blood are placed in a Cutler graduated tube containing 0.5 cc. of 3 percent sodium citrate solution to prevent clotting. As the blood settles a reading is made every 5 minutes for 1 hour and recorded on a graph. The normal sedimentation index for men is 2–8 mms. It is slightly higher for women. Sedimentation increases with increasing destructive processes of disease; hence it is a good prognostic indicator. (See fig. 388.)

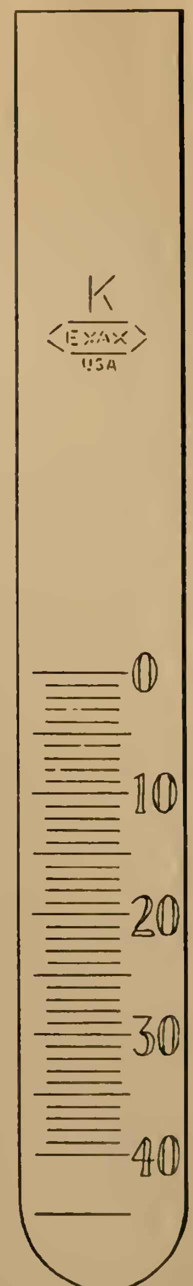


Figure 388.—Cutler Graduated Tube for Sedimentation Rates.

METHODS OF OBTAINING BLOOD

Capillary Blood Technique

For most clinical examinations, blood is best obtained from a vein. To make differential counts, cell counts, and coagulation and bleeding time, one may obtain blood from the lobe of the ear, the palmar surface of the tip of the finger, or, in the case of infants, the plantar surface of the great toe or of the heel. In case of the ear, the edge of the lobe, not the side, should be punctured. With most patients the finger will be most convenient. An edematous or congested part should be avoided; also a cold, apparently bloodless one. The site should be rubbed well with alcohol to remove dirt and other debris and to increase the amount of blood in the part. After allowing sufficient time for the circulation to equalize, the skin

is punctured with a blood lancet or with a short, stout, sharp, three-cornered needle. This may be fixed in the cork of a small vial that contains 70 percent alcohol. The puncture is practically painless if properly done with a sharp needle. It is made with a firm, quick stab, which, however, must not be so quick nor made from so great a distance that its site and depth are uncertain. The first drop of blood which appears should be wiped away, and the second should be used for examination.

The skin at the site of the puncture must be dry, else the blood will not form a rounded drop as it exudes. **The blood should not be pressed out,** since this dilutes it with serum from the tissues; but moderate pressure some distance above the puncture is allowable.

To Obtain Blood From a Vein

Cleanse the skin at the bend of the elbow by rubbing well with 70 percent alcohol and wipe the skin dry with sterile absorbent cotton. Place tourniquet firmly around upper arm. Instead of a tourniquet it will often be sufficient for an assistant or even the patient to grasp the upper arm firmly. Have the patient extend his arm fully and open and close the fist a few times to cause the veins to become distended. Even if not seen, they can usually be felt as cords beneath the skin. In fat persons veins which show as blue streaks are usually too superficial and too small. Grasp the forearm with the left hand, draw the skin tense with the thumb, and insert a sterile hypodermic needle attached to a sterile syringe into any vein that is prominent. The veins most often used are the basilic or the cephalic vein at the elbow. The needle should be large, about 19 to 21 gage. It should go through the skin about 3 mm. from the vein with the bevel at its tip uppermost, thus requiring two movements, one to puncture the skin and one to enter the vein. The size of the syringe to be used depends on the quantity of blood required and the size of the operator's hands.

When sufficient blood is obtained remove the tourniquet; then withdraw the needle. This order is followed to avoid formation of a hematoma. If the needle is sharp and smooth the procedure causes the patient surprisingly little inconvenience, seldom more than does an ordinary hypodermic injection. There is rarely any difficulty in entering a vein except in children and in adults when the arm is fat and the veins are small. If desired, one of the veins about the ankle can be used. Plate No. XI illustrates methods used in obtaining blood from a vein, with some precautions, and the correct position for the needle.

Safety Factors

Hemologous serum jaundice may be transmitted to individuals through the use of unsterile syringes, needles, and other equipment used to administer parenteral injections or to collect blood specimens. Although the virus of this disease is relatively resistant to many bactericidal agents, heat will apparently destroy it. In the elimination of the hazard of transmitting the infection, the following should be routinely observed:

1. Skin punctures to obtain blood specimens should be made with plain lancets, solid needles, or knife blades and should be carefully sterilized by heat before each use.
2. Venipunctures for collecting blood specimens should be made only with sterile needles and syringes. Bleeding with the sterile needle only is considered to be the most practical technique when large numbers of specimens are to be taken, as for serologic tests. Accidental contamination of needle shafts should be avoided.

BLOOD GROUPING AND MATCHING

Blood transfusion, the term used for the process of transferring blood from one person to the circulation of another, is often a life-saving remedy, especially in cases of severe hemorrhage, anemia, and infections.

In 1900 Landsteiner provided the basis for the present methods of determining the compatibility or incompatibility of blood for transfusion.

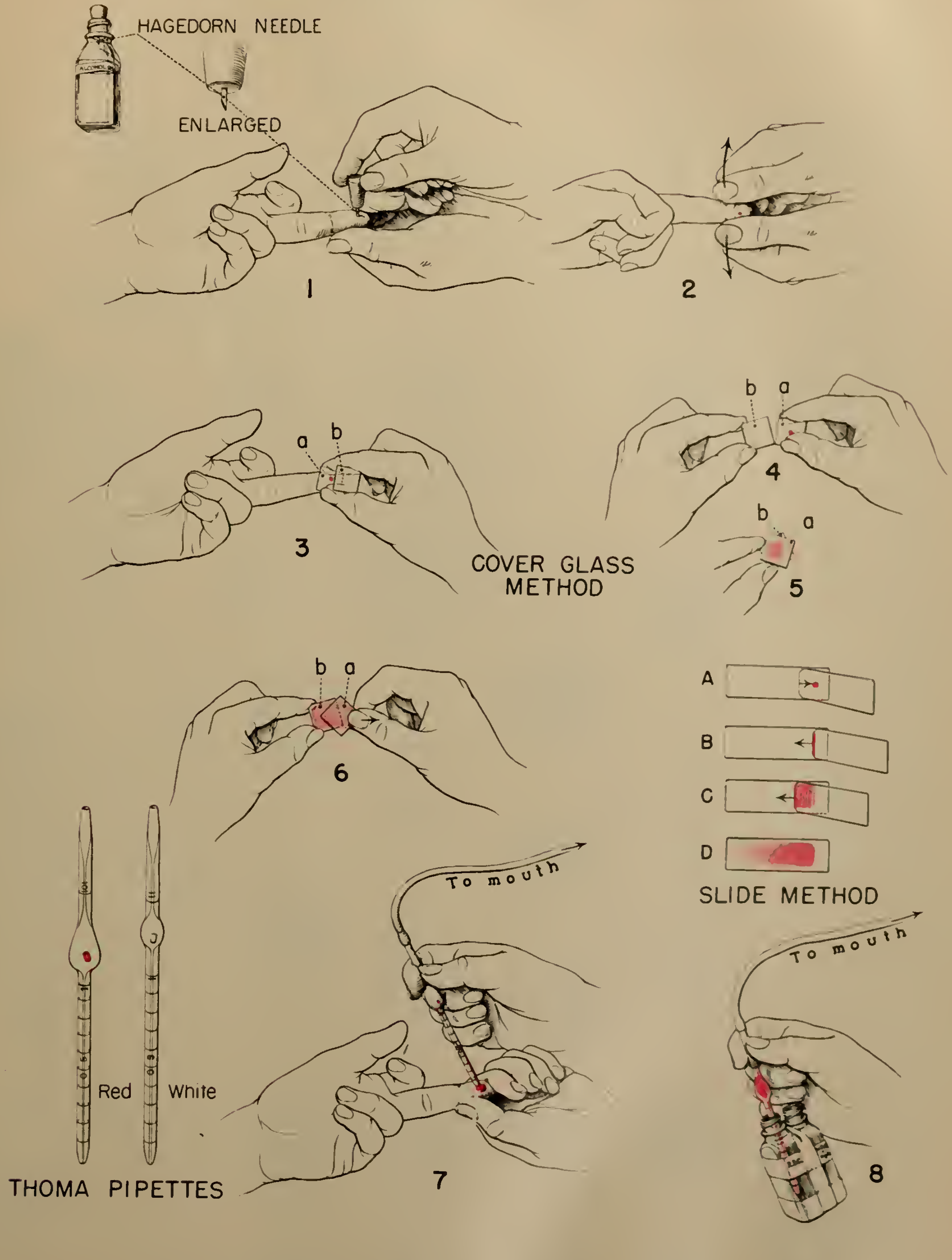
Classification

The Navy designates the four blood groups by the Roman capitals O, A, B, and AB.

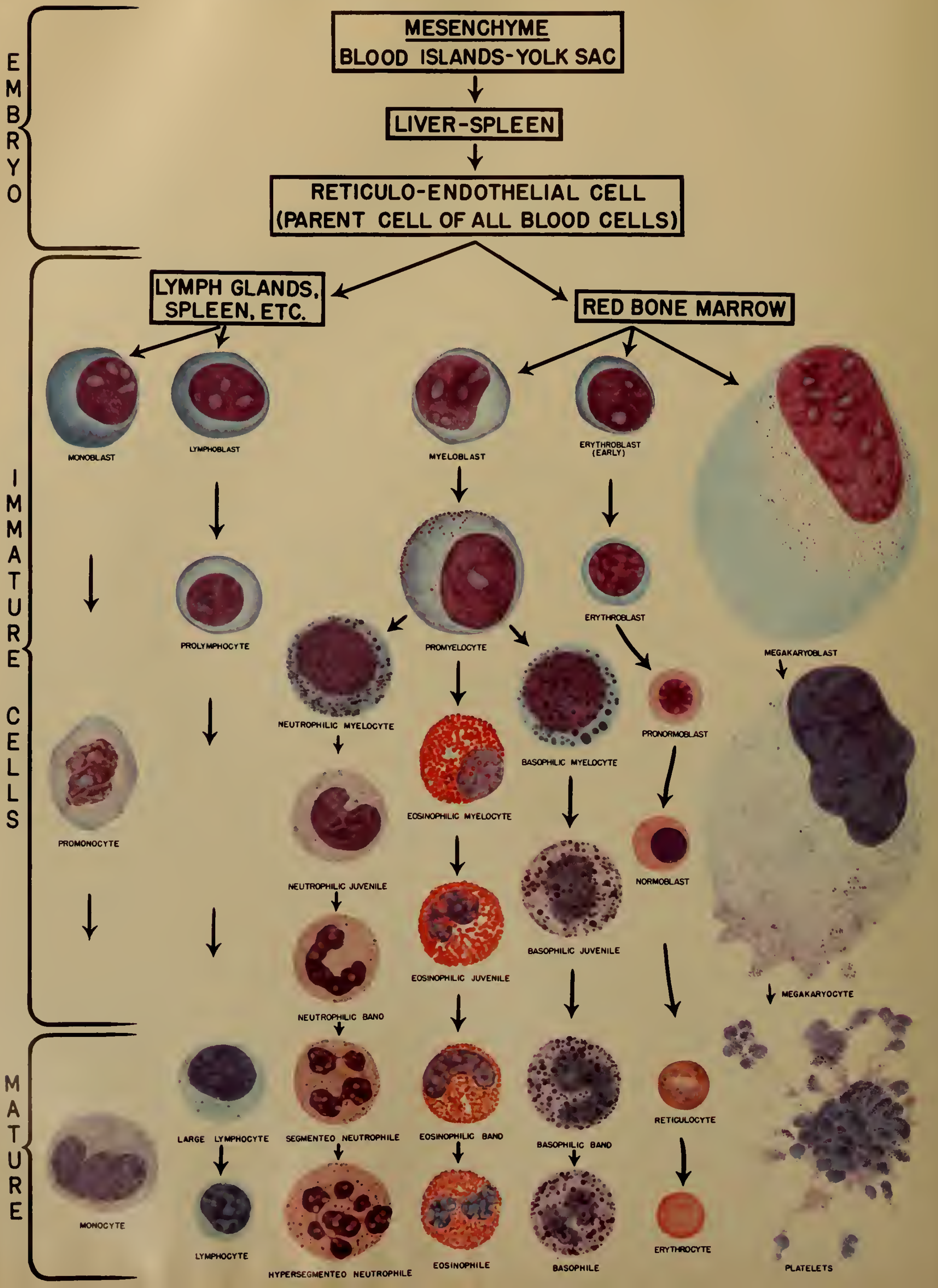
Agglutination

The work showing that all bloods can be classified into four groups was done by random cross-matching of the bloods of a large number of people. Two specific antigens (the isoagglutinogens or the agglutinable substances), identified by the small

BLOOD COUNTING TECHNIC



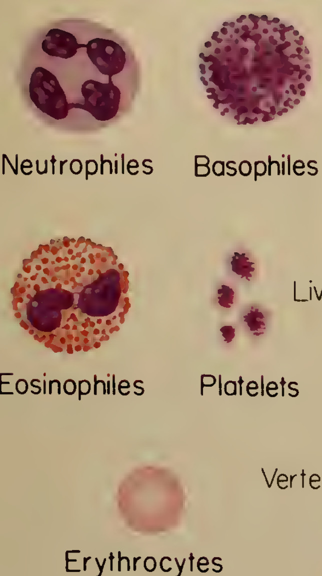
DEVELOPMENT OF BLOOD CELLS X 1500

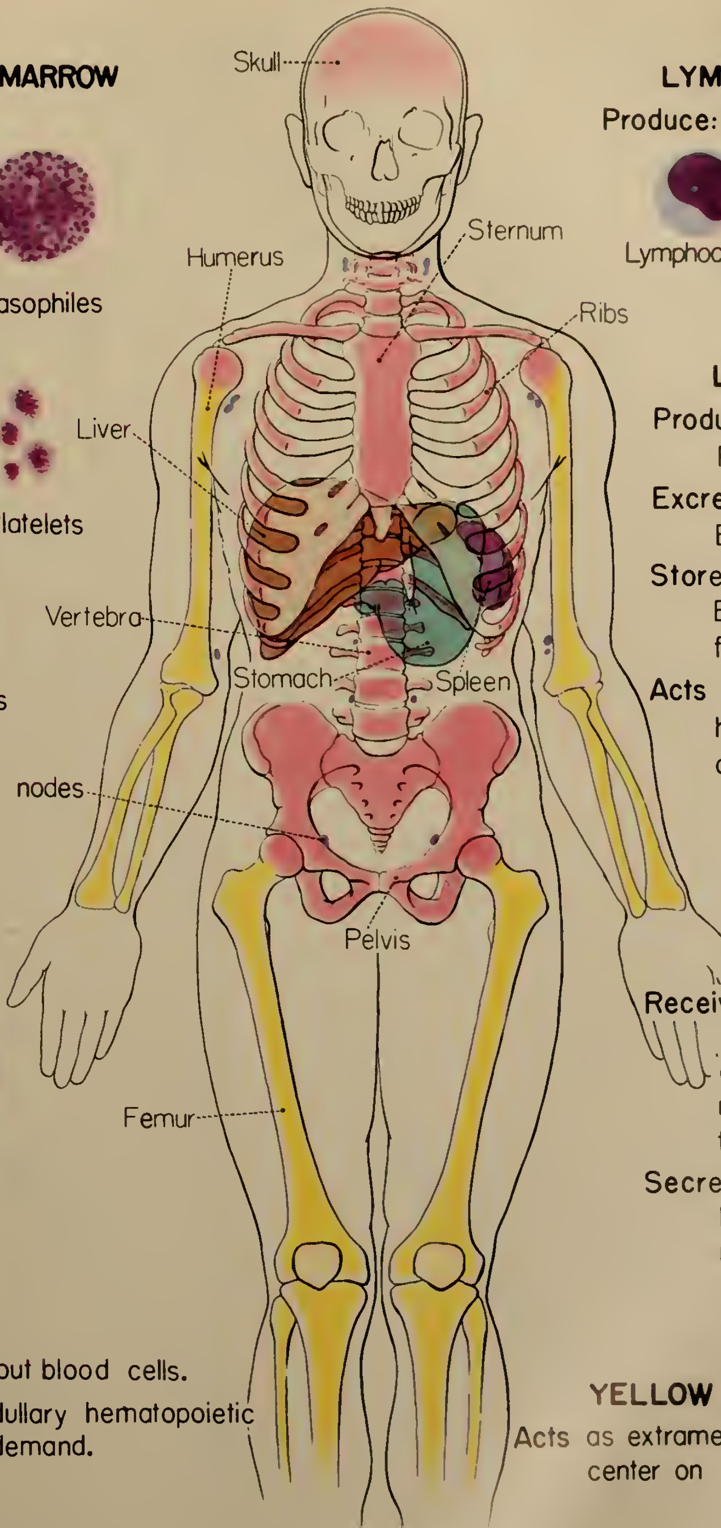


THE HEMATOPOIETIC SYSTEM

RED BONE MARROW

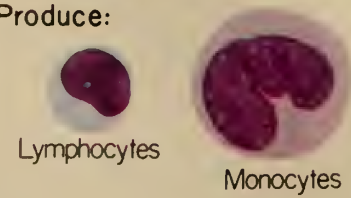
Produces:





LYMPH NODES

Produce:



LIVER

Produces:
Prothrombin, tibrinogen.

Excretes:
Bilirubin

Stores:
Erythrocyte maturing factor.

Acts as extramedullary hematopoietic center on demand.

SPLEEN

Produces:

Destroys: Worn out blood cells.

Acts as extramedullary hematopoietic center on demand.

STOMACH

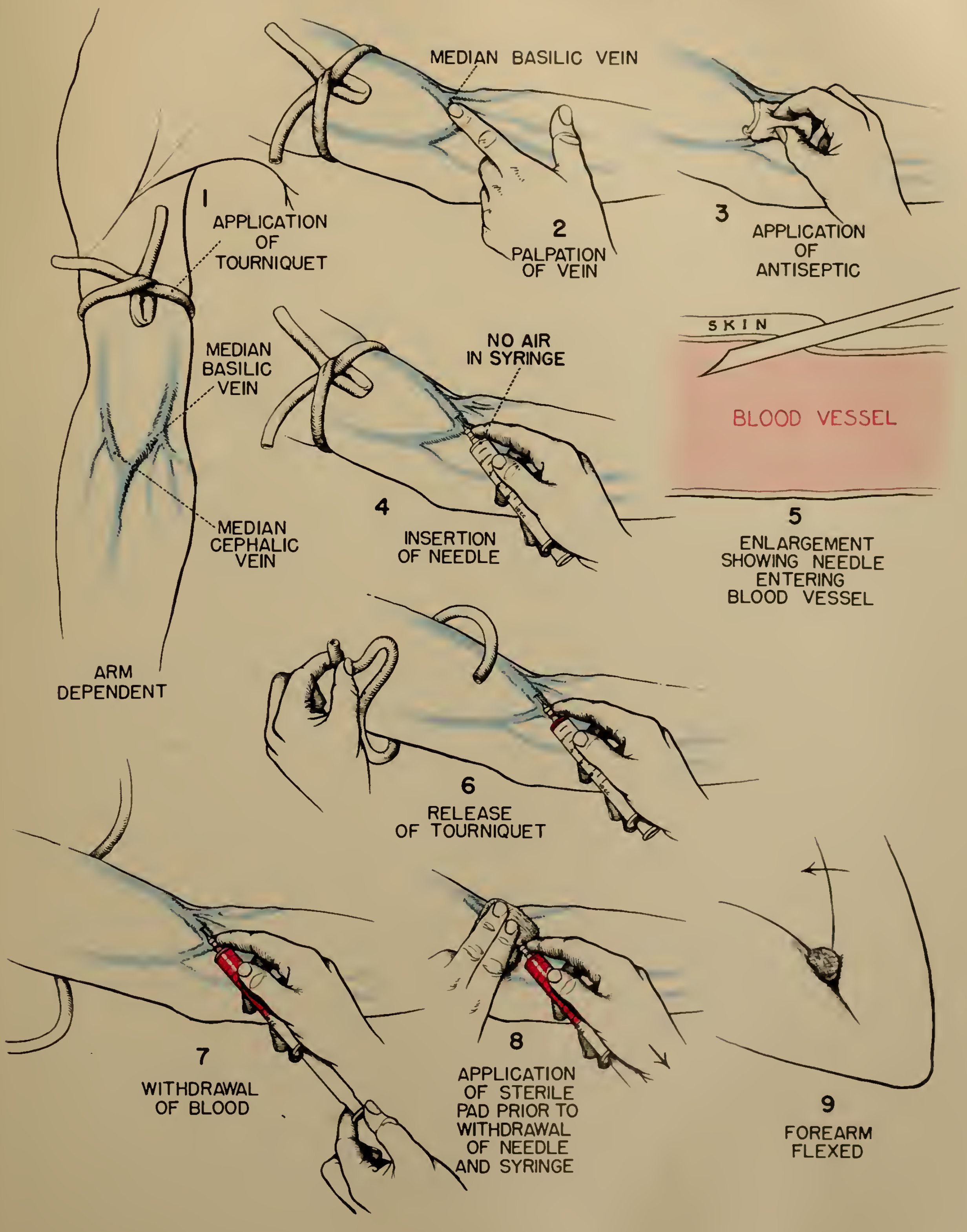
Receives:
Iron, protein and extrinsic erythrocytic maturing factor from food.

Secretes:
Intrinsic erythrocytic maturing factor.

YELLOW BONE MARROW

Acts as extramedullary hematopoietic center on demand.

TECHNIQUE OF VENIPUNCTURE



letters a and b, were found in the sera. The isoagglutinogens and isoagglutinins are never present simultaneously in the same blood. The table following shows the distribution of the isoagglutinogens and the isoagglutinins in the various blood groups:

Distribution of the isoagglutinogens and isoagglutinins in the four blood groups:

International group	Agglutinogens in red cells	Agglutinins in serum	Percentage of individuals in group
O	None	a and b	43
A	A	b	40
B	B	a	7
AB	A and B	None	10

To determine the group to which a blood belongs it is necessary to mix separately a suspension of its red cells with serum of a known group A and group B which contain agglutinin b and agglutinin a, respectively. The resulting agglutination, or absence of agglutination, determines the group to which it belongs and is a necessary procedure with the blood of both the donor and recipient. One of four possible combinations of reactions, as shown in the following table, will result:

AGGLUTINATING REACTIONS OF THE RED CELLS OF THE FOUR BLOOD GROUPS

International blood group	Serum A (b)	Serum B (a)
O	−	−
A	−	+
B	+	−
AB	+	+

− Denotes absence of agglutination.
+ Denotes presence of agglutination.

Technique of Blood Grouping

Preparation of Grouping Sera

Group sera A and B can be prepared readily but are usually obtained from some large or central laboratory. Under absolutely sterile precautions, collect blood by venipuncture from healthy young adult males of blood groups A and of blood group B. Allow the bloods to clot; then loosen and separate the clots from the sera by centrifuging. Pipette off the sera and determine their agglutinating power by titration of varying dilutions of the sera against proper red cell suspensions.

For the purposes of preservation and distinctive coloration, to each cubic centimeter of serum A add 0.01 cc. of a 0.5 percent aqueous solution of basic fuchsin, and to each cubic centimeter of serum B add 0.02 cc. of an aqueous solution of brilliant green. Store in ampules or vials of suitable size.

Preparation of Red Cells To Be Grouped

As fresh cells are necessary this procedure should be done immediately, at least not more than 2 hours before the test is to be done. From a needle prick of the finger or of the ear lobe, collect two drops of blood (four drops if anemic) in a small test tube containing 4 cc. of 1 percent solution of sodium citrate made up in 0.85 percent sodium chloride solution. Mix thoroughly by sucking the mixture up and down with a clean medicine dropper which is left in the tube for future mixture and transference.

Procedure for Grouping—Slide Method

When only a few bloods are to be grouped this method will be found convenient and satisfactory. With a blue wax pencil, mark a capital letter A on the left end of a clean, double, hollow-ground slide, and on the right end a capital letter B; then rim the concavities with petrolatum. In the left concavity place one drop of grouping serum A and in the right, one drop of grouping serum B. Then to each add one drop of physiological salt solution and one drop of the red-cell suspension. The sera, salt solution, and cell suspension are mixed thoroughly by stirring with individual clean toothpicks or by rotating and tilting. Drop a cover glass on the petrolatum ring to prevent evaporation. The preparation is then examined at intervals under the low power lens of microscope for the presence or absence of agglutination. Agglutination usually takes place in from 5 to 10 minutes, but if it does not the preparation should be inspected at intervals for 1 hour because the agglutinogens may be weak and the red cells may not clump for 45 minutes or more. If agglutination takes place the red cells gather in dense, irregular groups which appear to the naked eye as

"brickdust" granules which will not be broken up by stirring or shaking. If there is no agglutination, the red cells will be fairly evenly distributed over the field and will remain so for hours. (See fig. 389.)

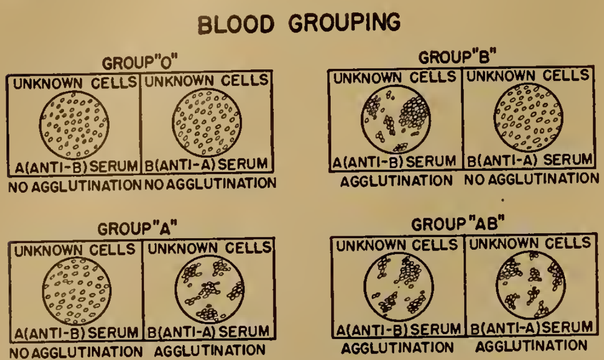


Figure 389.—Blood Grouping. Note distinctive clumping of cells with agglutination, and the even distribution of cells without agglutination.

Caution.—Droppers must be used only in their respective sera and cell suspensions. Toothpicks used for mixing serum A and the cell suspension must *not* be used for mixing serum B and cell suspension, and vice versa.

Test Tube Method

When a large number of bloods are to be grouped this method is recommended. Set up a double row of test tubes measuring 1 cm. inside diameter by about 7.5 cm. long in Kahn or other suitable test tube racks. Each pair of tubes is numbered consecutively; i. e., both tubes of the left hand pair are labeled No. 1, the next pair No. 2, etc. Deliver to the bottom of each tube in the front row one drop of serum A, to the bottom of each tube in the back row one drop of serum B, and to the bottom of all tubes one drop of physiological salt solution. Then to each tube of pair No. 1 add one drop of the cell suspension of the first blood to be grouped, and to each tube of pair No. 2 one drop of the cell suspension of the second blood to be grouped, etc., being careful that the cell suspension reaches the bottoms of the tubes, not the side walls.

Give each rack a few short, quick shakes to mix the contents of each tube. Observe and shake several times over a period of 1 hour, giving the tubes a final shaking at the end of the hour, at which time the final reading is made.

If there is agglutination, red clumps of cells may be seen by the naked eye; but if agglutination is doubtful or is apparently negative, transfer the contents of the tubes in question to a glass slide and observe under the low-power lens of the microscope. The same cautions concerning droppers, etc., apply as in the slide method. There will be very little evaporation from the tubes during the time taken to perform the tests. Greater quantities of grouping sera, saline, and cell suspension may be used, but the given amounts are satisfactory and grouping sera are not wasted.

Cross-Match Technique

When the recipient's or patient's blood group is ascertained, a donor of the same group is obtained. From a vein of the patient draw 3 or 4 cc. of blood into a syringe. Using two drops of the blood, prepare a cell suspension as previously described. Place the remaining blood into another tube and allow to clot in order to obtain the serum as described under preparation of grouping sera. Blood from the donor is similarly collected and treated. Mark a double, hollow-ground glass slide as shown in Figure 390. On the left side place one drop of the patient's serum and one drop of the donor's cell suspension. On the right side place one drop of the donor's serum and one drop of the patient's cell suspension. Mix and proceed as in the slide method of grouping.

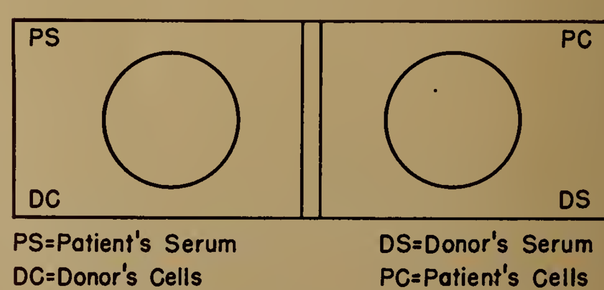


Figure 390.—Marked Slide for Cross Match Technique.

If no agglutination or hemolysis on either side takes place in 60 minutes, the bloods are compatible. If agglutination or hemolysis takes place on either side or both sides, they are not compatible and another donor must be cross-matched.

However, in extreme emergency a blood may be used for transfusion which shows agglutination or hemolysis of the patient's cells by the donor's serum, as the donor's serum is greatly diluted in the patient's blood. If the serum of the patient agglutinates or hemolyzes the donor's cells, the blood of the donor must not under any circumstances be used in transfusing the particular patient.

Precautions

1. Grouping sera of high agglutinating titre must be used to avoid false negative reactions, but the titre should not be high enough to cause rapid hemolysis as it will mask the results. Freshly prepared grouping sera are more likely to cause hemolysis.

2. Stock-grouping sera should be checked frequently for deterioration.

3. Avoid low temperatures in doing the test as it will occasionally bring out a so-called "cold agglutinin," besides slowing up the reactions. Room temperature or 37° C. is best.

4. Do not let preparations dry out—the reason for the petrolatum ring.

5. All suspension must be fresh or the cells may be agglutinated by all sera.

6. Avoid too heavy cell suspensions and keep them mixed to cut down rouleau formation which might be mistaken for agglutination.

7. Weak agglutinogens or agglutinins may lead to false group determinations or cross-matchings; therefore allow the full hour's observation in doubtful or apparently negative reactions and observe under the microscope before the final conclusion is made.

8. In cases of repeated transfusions cross-match before each transfusion, even though the same donor is to be used and was previously compatible. Iso-antibodies may have developed in the blood of the patient and cause a severe reaction.

9. The "universal donors" (i. e., those of group O) are frequently used as it is assumed that their cells are not agglutinated by any human sera. Severe and even fatal reactions have occurred because certain group O sera contain strong agglutinins for A cells or B cells or for both. It is better that the recipient and donor be of the same group.

10. Be certain all slides and tubes are labeled correctly and that the results are recorded correctly and properly.

11. Cross-match before every transfusion as it may save much embarrassment.

Selection of a Donor

The donor must be a healthy individual (preferably a young male) who is free from infectious diseases. Syphilis and malaria must be excluded. A Kahn or Wassermann test should be done on every donor just prior to giving blood for a transfusion, but a history and careful physical examination are also necessary. Syphilis has been conveyed by blood from donors with primary syphilis but whose Wassermann reactions were negative. Malaria has been transmitted, even from old latent cases. It is much safer to reject all donors with a history of syphilis or malaria even though their bloods are negative.

A donor should not be used a second time until his blood volume, hemoglobin, and red cell count have returned to normal; this usually takes from 4 to 6 weeks.

The corpuscles of about 85 percent of human beings also contain the Rh agglutinogen (Rh+) discovered by Landsteiner and Wiener. Agglutinin for Rh+ does not occur normally in the blood. Consequently, Rh+ corpuscles do not produce reactions in first transfusions. However, the agglutinogen is antigenic and multiple transfusions with Rh+ corpuscles may produce an Rh agglutinin. The latter may also be produced during pregnancy through iso-immunization by Rh agglutinogen in the fetus. The agglutinin is also of the "cold" type but the presence of large amounts in the blood of recipients may produce reactions upon transfusion with Rh+ corpuscles; probably it is also responsible for erythroblastosis fetalis. Consequently, it is advisable to select compatible donors whose corpuscles are Rh− for the transfusion of individuals who have had previous transfusions (especially with Rh+ corpuscles) as likewise for the first and subsequent transfusions of women in pregnancy and the puerperium.

ANIMAL PARASITOLOGY

Parasitology is the study of animal parasites. An animal parasite may be defined as an animal living in, on, or with some other living organism, its host, at whose expense it obtains food and shelter. Parasites such as hookworms and tapeworms live within the host and are called endoparasites. Lice are called ectoparasites as they live upon the body of the host.

Classification

All the common parasites of man may be classified in three main groups: protozoa; helminths or worms; and the arthropoda such as mites, ticks, and insects.

Protozoa are animals consisting of a single cell, and due to their small size they are always studied under a microscope. They are of medical importance because certain species inhabit various parts of the human body and cause disease such as malaria, amoebic dysentery, and African sleeping sickness.

The protozoa may be divided into: (1) intestinal protozoa; (2) blood and tissue flagellates, and (3) malarial parasites.

Intestinal protozoa includes the amoeba of which there are five species found as parasites in the intestine of man. Only one, *Endamoeba histolytica*, is responsible for serious disease, amoebiasis. It exists in two stages, motile and encysted, and is transmitted by ingestion of the cysts in food or water. Other amoeba found in the intestine of man are all considered harmless. These are *Endamoeba coli*, *Indolimax nana*, *Indamoeba butschlii*, and *Dientamoeba fragilis*. These amoeba are important only for the fact that it is sometimes difficult to differentiate them from *Endamoeba histolytica.*

Other intestinal protozoa other than the amoeba which may be found are *Giardia lamblia*, *Chilomastix mesnili*, and *Trichomonas hominis*. Although these three species are usually considered harmless, it is now believed by some investigators that *Giardia* is sometimes pathogenic.

Technique for Demonstration of Protozoa in Feces

Place a drop of physiological saline on a slide. Select a small particle of feces with an applicator and stir it in the drop of saline until it forms a smooth emulsion. Apply clean cover slip over the emulsion. The film should be thin and uniform so that when seen under the microscope the fecal particles and protozoa will be clearly illuminated. In thicker films the protozoa are frequently missed, and if found, they are partially hidden in the fecal matter and difficult or impossible to identify. For microscopic identification always use the 16 mm. or low-power objective to find the protozoa, never the high-dry or 4 mm. objective. Open the iris diaphragm to its widest position and use the concave side of the mirror. Focus on the field, then gradually lower the condenser until a point is reached where there is maximum refractility and minimum glare. This point can only be determined by experimentation. It varies for every microscope and individual. Rotate the fine adjustment knob up and down, and all refractile objects in the field should sparkle. Intestinal protozoa will stand out in this light as refractile, shining bodies that are colorless or have only the slightest greenish or bluish tint. The beginner will find it difficult to locate and identify intestinal protozoa, especially forms less than 10 microns in diameter, but it is essential to learn to search with the lower magnification in order to save time and examine more material. Also the important quality of refractility is lost with the higher power objectives.

The 4 mm. objective is usually required to bring out the morphological features necessary for differentiation. Some smears will have so many refractile, shining bodies resembling intestinal protozoa when viewed with the 16 mm. objective that it may be more convenient to search with the high-dry lens. This procedure avoids changing objectives constantly to identify suspicious looking objects. No matter how devoid of intestinal protozoa or protozoan-like objects the smear may appear to be under the 16 mm. objective, the technician should always check his findings by searching back and forth across the smear with the high-dry lens. At times, he may find that he has missed the small motile trophozoites or cysts.

Iodine Stained Smears for Protozoan Cysts

This is a temporary stain used for quick diagnosis on fresh material. It must be made fresh

every ten days or it will not stain properly. It is prepared in the following manner:

Iodine	2 gm.
Potassium iodide	4 gm.
Distilled water	100 cc.

Dissolve the potassium iodide in water, add the iodine and dissolve.

Procedure for examination with iodine solution

(1) Emulsify as when making the saline smear, using a few drops of the iodine solution in place of saline; (2) examine under microscope; (3) prepare several smears before making a negative report. In practice a saline smear may be made on one end of the slide and the iodine smear on the other end. The iodine solution will cause the starch cells to show blue under the microscope, eliminating them as possible protozoa.

INTESTINAL PROTOZOA

Endamoeba Coli (Figure 391)

Small races of *Endamoeba coli* are uncommon; it is usual to find these forms significantly larger than those of the other amoebas. Only the giant *E. histolytica* trophozoites in amoebic dysentery attain or surpass those of *E. coli* in size. In this species, the characteristic immature cyst is binucleate, while the typical cyst of *E. histolytica* is uninucleate. Ninety-five percent of the cysts of *E. coli* are either binucleate or eight-nucleate, the predominating number depending upon the consistency of the feces.

1. and 2. Two trophozoites, about 25 and 30 microns long, respectively. The karyosome is large and eccentrically placed; the chromatin granules on the nuclear membrane are deposited irregularly. The endoplasm is profusely vacuolated and dirty with visible food inclusions.

3. An abnormally large immature uninucleate cyst (rare). The glycogen vacuole is large and conspicuous. Many authorities prefer to call this form a pre-cystic stage.

4. A young immature binucleate cyst, about 17 microns in diameter (rare).

5. The characteristic immature binucleate cyst (a very common type). The nuclei assume diametric positions, crowded against the cyst wall by the glycogen vacuole. Scattered chromatoid granules surround the vacuole.

6. An immature quadrinucleate cyst (rare). The nuclei, each of which must undergo another division, are much larger and more centrally placed than in the quadrinucleate cyst of *E. histolytica*.

7. An immature five-nucleate cyst (rare). The three larger nuclei must undergo another division.

8. An immature six-nucleate cyst (rare). The two larger nuclei have not undergone final division. The majority of the chromatoidal material has been absorbed, not unusual in immature cysts of *E. coli*.

9. A mature eight-nucleate cyst (a common type). The spindle-shaped, sharply pointed chromatoid bodies are distinctive for *E. coli*.

10. A mature cyst with filamentous chromatoid bodies, commonly seen in this species.

11. A mature cyst with only a small speck of chromatoid matter remaining (a common type).

12. A mature cyst without chromatoid matter (a very common type).

INTESTINAL PROTOZOA

Endamoeba Histolytica (Figure 392)

1. A trophozoite from a nondysenteric case ("carrier"). The chromatin granules on the nuclear membrane are uniform.

2. A trophozoite in amoebic dysentery, although there are no ingested red cells. The parasite is over 16 microns in length. The small karyosome is centrally placed.

3. A giant trophozoite containing ingested red cells in various stages of absorption. The nucleus is characteristic.

4. An immature uninucleate cyst (a very common type). The chromatoid matter is scattered and the outline of the glycogen vacuole is visible.

5. An immature uninucleate cyst with a large nucleus and a definite glycogen vacuole (a very common type). Note that the nucleus is not crowded by the vacuole. Chromatoid grains are scattered around the periphery of the cyst.

Figure 391.—Endamoeba coli.

Figure 392.—Endamoeba histolytica.

6. An immature cyst in which the nucleus is dividing (rare).

7. An immature cyst with two nuclei (rare). The glycogen is less definite, but the chromatoid matter is forming into bars and chunks.

8. A trinucleate cyst, one nucleus being larger than the other two (rare). A single chromatoid bar with rounded ends is present.

9. A mature quadrinucleate cyst (a very common type). The glycogen has been absorbed; the nuclei are characteristically placed. The chromatoid bar is diagnostic.

10. A mature cyst with characteristic nuclei and chromatoid bars (a very common type). Note the vacuolization.

11. A mature cyst, larger than the average for this species. The chromatoid matter has been absorbed.

12. A trophozoite, small race. The granules on the nuclear membrane are uniform and the small karyosome centrally placed.

13. An immature uninucleate cyst, small race. There is a large amount of chromatoid matter, the best diagnostic aid in the small race cysts.

14. An immature binucleate cyst with chromatoid bars. The glycogen is not so definite as seen in the large race cysts.

15. A mature quadrinucleate cyst with two chromatoid masses, one seen on end.

16. A mature quadrinucleate cyst in which the chromatoid matter has been absorbed.

CHARACTERISTICS OF COMMON AMOEBA OF MAN (CYSTIC STAGE)

	E. histolytica	E. coli	E. nana	I. butschlii
Size; shape	7–15 microns, roundish	10–25 microns, roundish.	6–10 microns, ovoidal.	6–16 microns, irregular.
Nuclei	Young, 1 or 2.0	Young, 1, 2, 4	Young, 1 or 2	Mature, 1.
Number	Mature, 4	Mature, 8	Mature, 4	
Chromatoid matter	Cigar-shaped bare with rounded ends; often absent.	Inconstant spicules present in about 10 percent.	None	None.
Clycogen mass	Rarely seen	Young cysts filled with glycogen. Deep brown.	None visible	Majority have large, deep brown ball (diagnostic).

Blood and Tissue Flagellates.—Found in the blood and other tissues of man are those protozoa that move by means of whiplike appendages or flagella. They belong to the genus *Leishmania* and the genus *Trypanosoma*. *Trypanosoma gambiense*, which causes African sleeping sickness, is an important member of this group. Diagnosis is made by finding the trypanosoma in the blood or tissues of man.

Malarial Parasites.—There are three important kinds of malarial parasites:

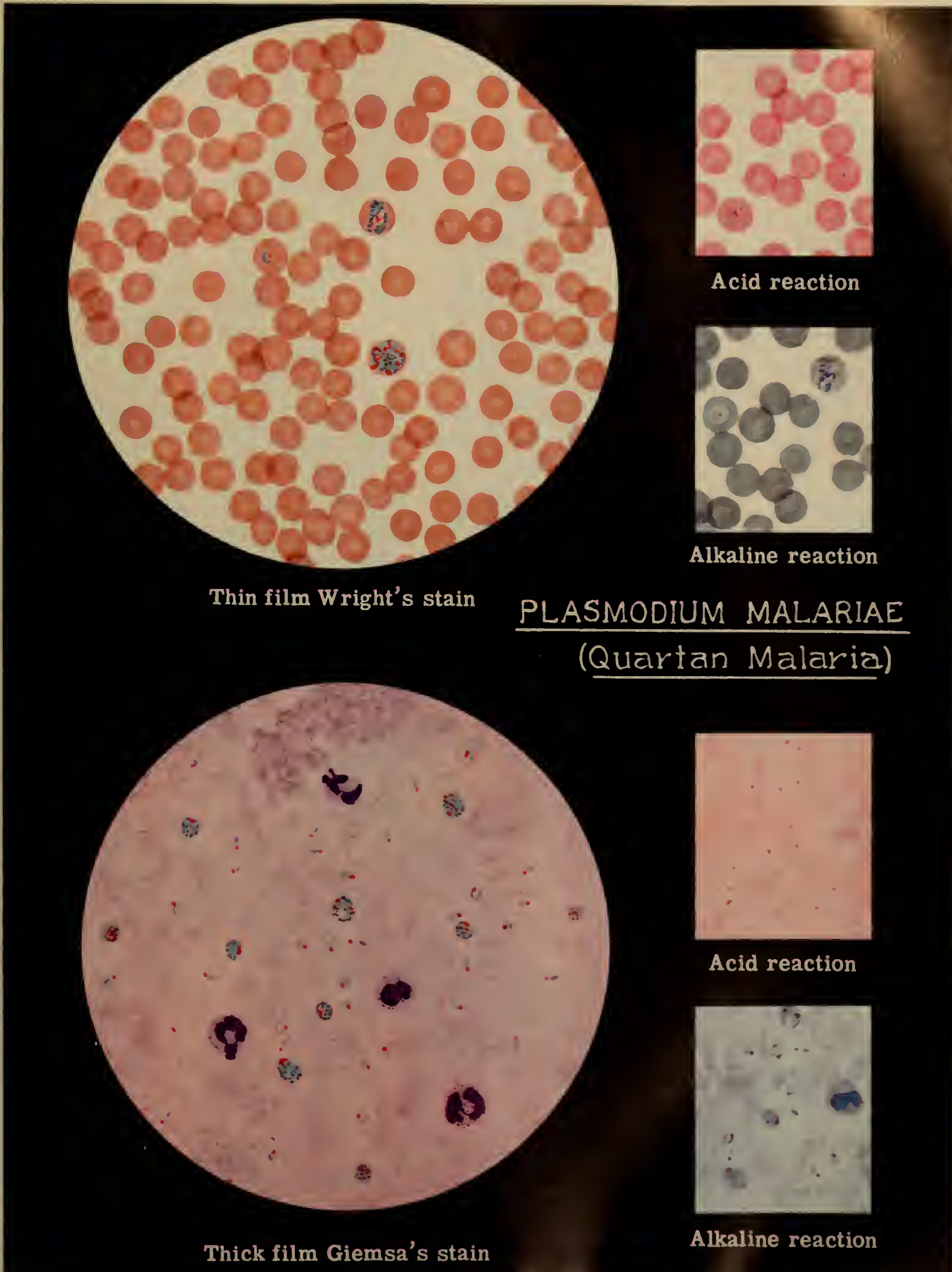
1. **Plasmodium vivax,** the cause of vivax or benign tertian malaria.

2. **Plasmodium malariae,** the cause of quartan malaria.

3. **Plasmodium falciparum,** the cause of malignant tertian malaria.

These parasites are protozoa which live parasitically in the tissue cells of the host and reproduce by forming spores. They require two hosts for their development, the definitive host, a mosquito (Anopheles); and an intermediate host which is man. The development in the mosquito requires 10 to 21 days, thus, an anopheles mosquito biting a man suffering from malaria cannot infect another man until after this time has elapsed.

In the body of a mosquito which has been infected by biting a person having some form of malaria the malarial parasite develops for from 10 to 21 days and then appears in the salivary glands of the mosquito in the sporozoite form and is ready for transmission to another host. By the bite of the infected mosquito the sporozoites are introduced into the blood stream of man. After a developmental period of approximately 10 days, they enter the red blood cells and are known as trophozoites. Within the red cells, the trophozoite grows in size and its single nucleus divides a number of times producing a form called a schizont. The red cell eventually ruptures, re-



PLASMODIUM MALARIAE
(Quartan Malaria)

Thin film Wright's stain

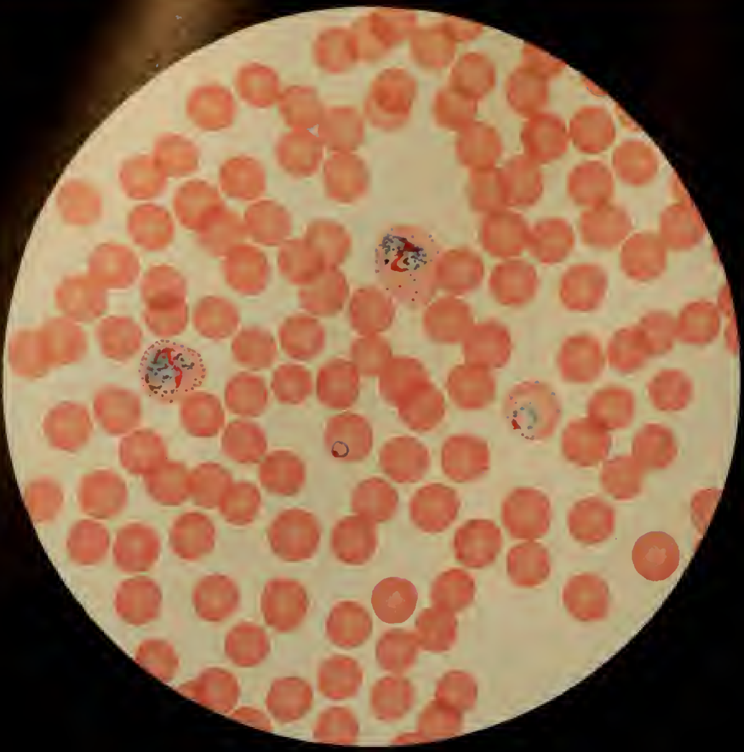
Acid reaction

Alkaline reaction

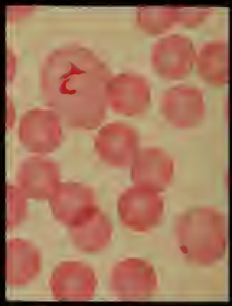
Thick film Giemsa's stain

Acid reaction

Alkaline reaction



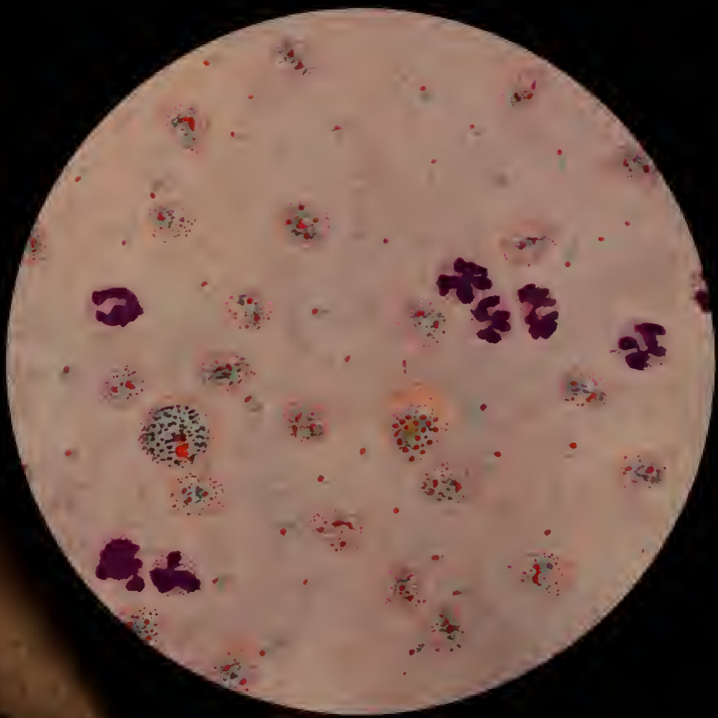
Thin film Wright's stain



Acid reaction

Alkaline reaction

PLASMODIUM VIVAX
(Tertian Malaria)



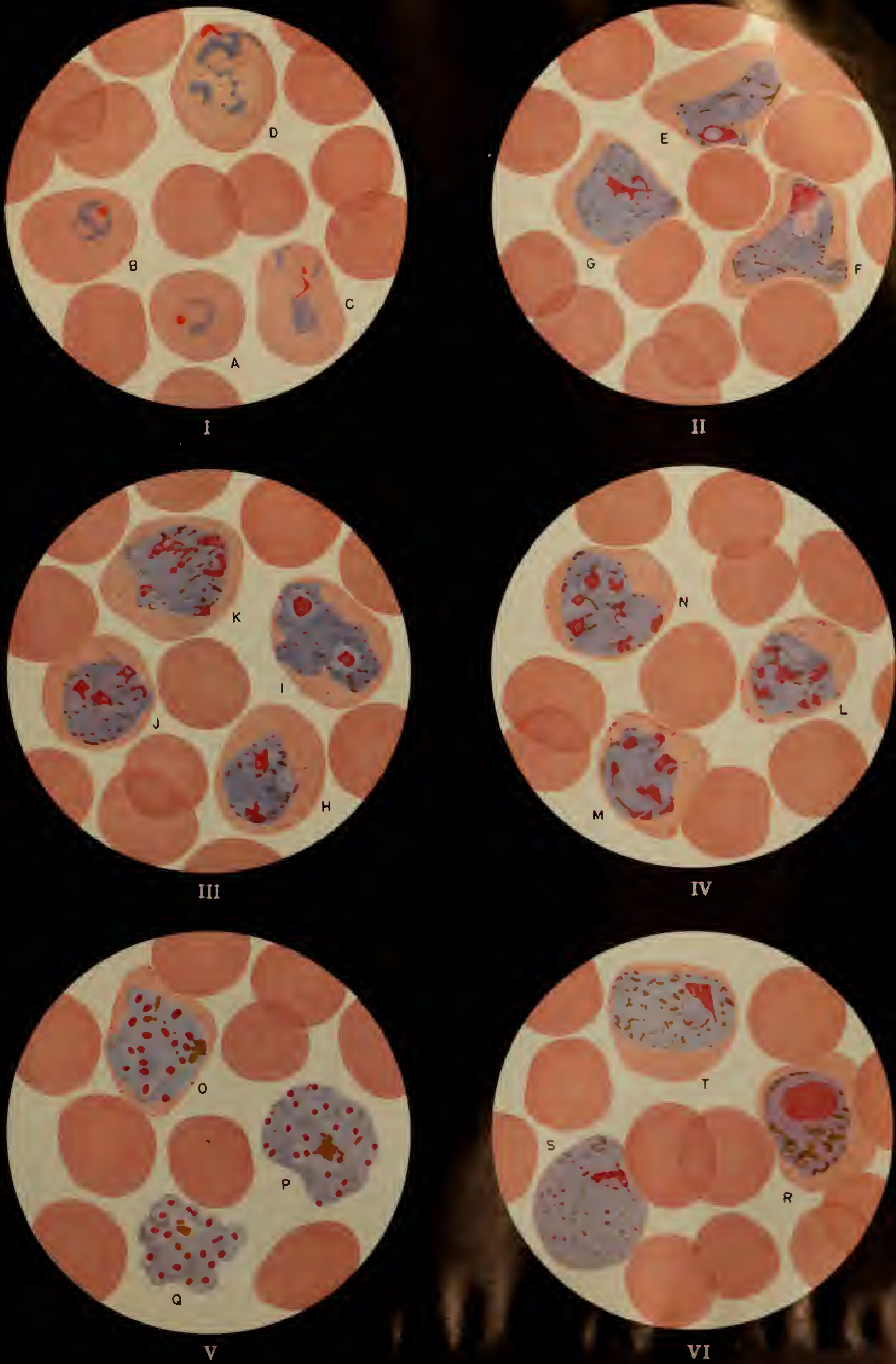
Thick film Giemsa's stain

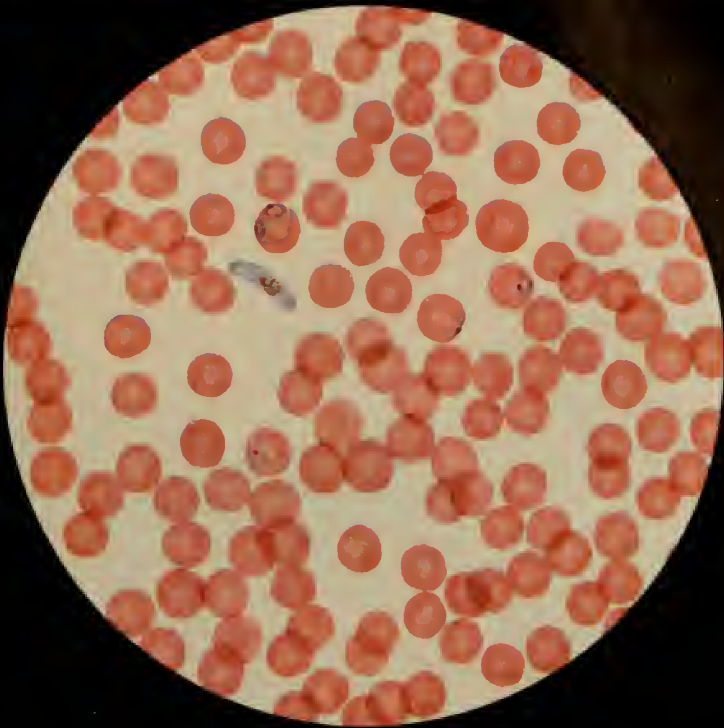
Acid reaction

Alkaline reaction

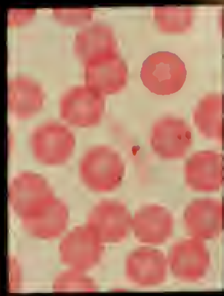
PLATE 14

PLASMODIUM VIVAX (TERTIAN MALARIA) GIEMSA STAIN

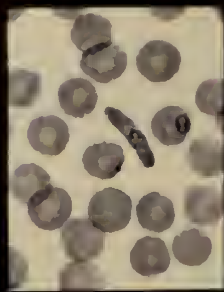




Thin film Wright's stain

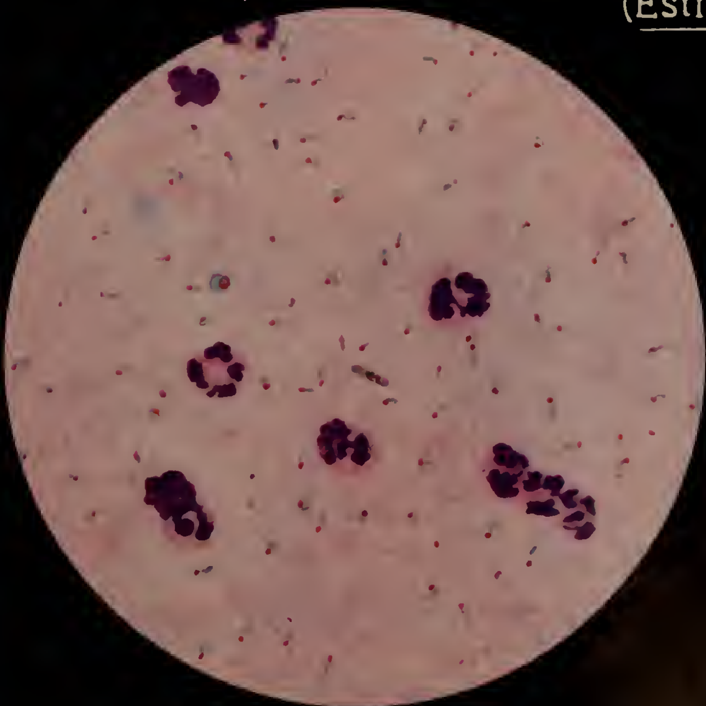


Acid reaction



Alkaline reaction

PLASMODIUM FALCIPARUM
(Estivo-Autumnal Malaria)

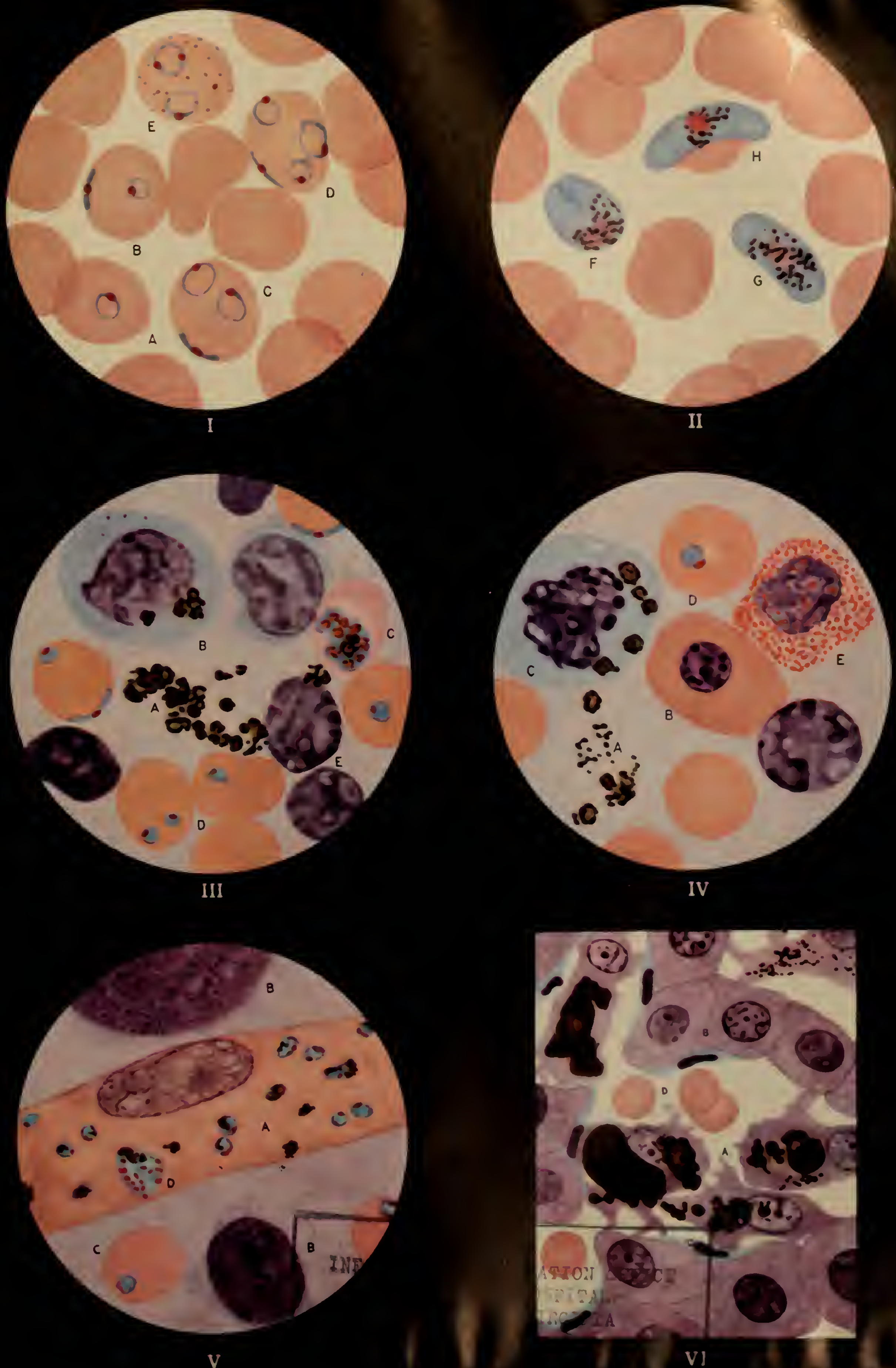


Thick film Giemsa's stain

Acid reaction

Alkaline reaction

PLASMODIUM FALCIPARUM (ESTIVO-AUTUMNAL MALARIA) GIEMSA STAIN



leasing each tiny nucleus with its attendant bit of cytoplasm. These new forms called merozoites attach themselves to new red cells and become trophozoites. This cycle from trophozoite through schizont to merozoite and back to trophozoite requires approximately 48 hours in vivax, 72 hours in quartan, and 36 to 48 hours in malignant tertian malaria. The chill in malaria is coincident with the rupturing of the red cells and is attributed to the sudden liberation into the blood of toxic substances, possibly excretory material of the parasites from the disintegrated red cells.

EXAMINATION FOR MALARIAL PARASITES

Preparation of Smear

Thin-stained film method:

1. Smears are prepared with cover glasses or slides in the same manner as for differential leukocyte counts, but the films must be so thin that the erythrocytes lie flat and are well separated.
2. Fix and stain with Wright's or Giemsa's stain in the same manner as staining for differential leukocyte counts.
3. Dry and examine with oil-immersion objective.
4. The smears must be well stained for satisfactory results. Unless the nuclei of leukocytes are well stained and have the proper reddish purple tint due to proper staining of the chromatin, the chromatin of the plasmodia will not be properly stained. Good and poor areas may occur on the same slide.
5. Malaria plasmodia are in the erythrocytes, and no object should be considered as a probable plasmodium unless it is so situated.
6. With Wright's or Giemsa's stain the chromatin of the parasite will take on a ruby-red color, the protoplasm of the organism a sky-blue (pale blue), the pigment a black or dark brown, and the blood platelets and the nuclei of the leukocytes a reddish purple.
7. Great care should be exercised to avoid mistaking the blood platelets accidentally superimposed upon red cells for malarial parasites. These platelets are frequently surrounded by an unstained halo. Precipitated stain, dirt, bacteria, etc., may constitute other sources of error.
8. Precipitated stain granules may be removed by immersing the slide for a second or two in 95 percent alcohol and immediately washing with distilled water.

Thick-stained film method.—This method is useful when there are but few parasites and thin films are negative. It is of particular value for the detection of plasmodia in malarial surveys and in patients with chronic malaria or under treatment.

1. It is essential to carefully clean the skin with alcohol and gauze in order that the blood be free of dirt, bacteria, or other debris. The slides should be perfectly clean.
2. Place 4 medium-sized drops of blood on a slide at the corners of a ½-inch square.
3. Draw the drops into a pool with a needle so that a thick moist layer ½-inch square is formed.
4. Allow the film to dry for 1½ hours in an incubator at 37° C. or overnight at room temperature, protected from dust by an inverted Petri dish. The smears should be dried only long enough to make them adhere, since too much drying will prevent satisfactory staining of the parasites.
5. Flood the film with a mixture of 4 parts of a 2.5 percent aqueous solution of glacial acetic acid and 1 part of an aqueous solution 2 percent tartaric acid until a grayish white color denotes completion of dehemoglobinization. Treatment with distilled water or weak acids will also produce dehemoglobinization.
6. Wash with water, allow to dry, and stain with Wright's stain as in the staining of blood films for differential leukocyte counts.

Giemsa's staining method:

1. Blood film fixed by flooding cover slip or glass slide with methyl alcohol for 2 to 3 minutes.
2. Dry in air.
3. Flood with diluted stain for 15 to 20 minutes, wash with water, air dry and mount under oil-immersion lens, using drop of oil.

Giemsa's stain:

Azur II-Eosin	0.5 gm.
Azur II	0.08 gm.
Glycerin, antydrous, pure	25.00 cc.
Alcohol, Methyl, absolute	25.00 cc.

Warm glycerin to 60° C., dissolve the dyes in this. Warm the methyl alcohol to 60° C., and add. Allow to stand about 24 hours and filter. Just before using, dilute with 10 parts of distilled water.

Giemsa's stain may be procured in powdered form and is prepared by adding the glycerin and alcohol, or may be procured in liquid form and need only to be diluted with water.

Plates Nos. XII, XIII, XIV, XV, and XVI illustrate the three types of malarial parasites as they appear when stained with both Wright's and Giemsa's stain. These also show some of the various stages of the development of the parasites in the blood stream.

The Helminths, or Worms, may be classified into three groups: (1) Flukes (trematodes), (2) tapeworms (cestodes), and (3) roundworms (nematodes).

Adult flukes and tapeworms are flat and although the flukes may resemble leeches in appearance, they are in no way related. Adult tapeworms are ribbonlike and consist of a very small head followed by a long series of segments. Both the flukes and tapeworms possess suckers as a means of attachment to their hosts.

The roundworms or threadworms are tubular in shape. They are not segmented but are covered with a cuticle or skin which is frequently ringed.

Flukes.—Although there are many species of flukes which are parasitic to man, the more common are the following:

Manson's Blood Fluke (Schistosoma mansoni).—Man acquires the infection by swimming or wading in water containing the infective larval stage. These larvae (cercariae) penetrate the skin and enter the blood stream. The adult flukes usually inhabit the mesenteric vessels draining the large bowel. This species is found in Africa, Brazil, Venezuela, and Puerto Rico. Laboratory diagnosis: Eggs, in feces, measure 115 to 175 microns. They are thick-shelled with a pronounced lateral spine.

Oriental Blood Fluke (Schistosoma japonicum).—Infection acquired by same means as Manson's Blood Fluke. Adults inhabit mesenteric vessels draining the large bowel. This fluke is confined to the Orient. Laboratory diagnosis: Eggs, in feces, measure 70 to 100 microns and have a thick shell with small lateral depressed hook or knob.

Chinese Liver Fluke (Clonorchis sinensis).—Infection acquired by ingestion of encysted larvae while eating raw fresh-water fish. Adults live in bile passages of the liver and eggs pass down the bile ducts into the intestine. Their distribution is confined to the Orient. Laboratory diagnosis: eggs (28–35×12–20 microns) in feces are thick shelled with pronounced shoulders at the smaller end and contain fully formed larvae.

Oriental Lung Fluke (Paragonimus westermani).—Infection is by ingestion of raw crabs and crayfish harboring the encysted larvae. Adults are usually found in cysts of the lung. This species is found in Korea, Formosa, Japan, and Central China. Laboratory diagnosis: Eggs (80–120×50–60 microns) in sputum (or in feces) are thick-shelled and ellipsoidal-shaped.

Tapeworms

Several species of tapeworms may inhabit the intestinal tract of man, the common ones being:

Beef Tapeworm (Taenia saginata).—This is the most common human tapeworm. It is acquired by eating insufficiently cooked beef that contains the larval worm. The adults inhabit the small intestine. Laboratory diagnosis: Segments (proglottids) in feces have a central uterine stalk with 15 to 30 lateral branches.

Pork Tapeworm (Taenia solium).—Man is infected by eating insufficiently cooked pork containing the larval form. Adults inhabit the small intestine. Laboratory diagnosis: Segments in feces have a uterus showing only 5 to 10 lateral branches.

Dwarf Tapeworm (Hymenolepis nana).—This is one of the most common tapeworms and is called dwarf tapeworm due to its small size, it being only a quarter to a half inch in length. Infection is acquired by accidental ingestion of eggs. The adults inhabit the small intestine. No intermediate host is required, and the person harboring the infection can readily reinfect himself by accidentally ingesting eggs evacuated in his own feces. Diagnosis is based on recovering the eggs in the feces.

Roundworms or Threadworms

The common species found in man are the following:

Large Intestinal Roundworm (Ascaris lumbricoides).—This very common intestinal roundworm is acquired by ingestion of eggs through food or drink. The adults average about 6 inches in length and are grayish to reddish in color.

Diagnosis is based on demonstrating the eggs in feces.

Human Whipworm (Trichuris trichiura).—This is another common intestinal roundworm, especially in the tropics. Adults usually live in the cecum but may be found in other parts of the large bowel. Diagnosis is based on recovery of the eggs in the feces.

Hookworm (Necator americanus or ancylostoma duodenale).—Man is infected by invasion of the larvae through the skin. The adults live attached to the mucosa of the small intestine. Diagnosis is based on recovering the eggs in feces.

Pinworm or Seatworm (Enterobius vermicularis).—This worm is found more frequently in children than in adults. Infection is by ingestion of eggs. The eggs are usually embryonated when deposited on the perianal folds by the female who wanders out of the rectum to lay eggs. Eggs are not commonly found in the feces but a special technique with an anal swab (Graham swab) is required.

Bancroft's Filaria (Wuchereria bancrofti).—This is the most important of the filaria worms and causes an infection quite common in tropical countries. Man acquires the infection during the bites of infected mosquitoes. The adult worms inhabit the lymphatic vessels and the lymph nodes where the female deposits larval forms known as microfilaria which are carried into the blood stream. Diagnosis is made by the presence of the microfilaria in blood smears.

Methods of Examination for Helminth Eggs

Simple flotation technique.—For those species of worms which can be diagnosed by finding their eggs in the hosts' feces, the following procedure is employed:

Either of the following solutions may be used, however table salt (sodium chloride) is easily obtained and very efficient if used correctly.

1. Table salt (crude). Saturated solution NaCl; specific gravity about 1.20 or 1.21.

2. Table Sugar. Saturated solution (2 lbs. sugar; 1,125 ml. water). As a preservative, 10 ml. phenol are added.

Technique.—About 1 gm. of feces is thoroughly emulsified in a small amount of one of the above solutions in a suitable container. Glass vials, 2.5 cm. in diameter and 5.0 cm. tall are very satisfactory. The solution is added until it nearly fills the container. More is carefully added until a slight meniscus forms at the top of the vial. A slide (should cover entire area) is placed over the vial in contact with the meniscus. The covered vial is allowed to stand for 10 minutes to 1 hour (never over 30 minutes for the salt solution). The slide is removed by lifting it straight up; it is inverted and examined systematically by the low-power objective.

This method is satisfactory for the eggs of hookworm, large intestinal roundworm, whipworm, and the dwarf tapeworm. Figure 393 illustrates some ovum of the common parasites of man.

Scotch Tape Method (Graham Swab) for Pinworm Eggs

Technique.—A small strip of transparent scotch tape is placed, with the adhesive side out, over the end of a tongue depressor or blunt forceps. The tape is pressed over the anal opening and perianal folds, allowing the tape to pick up the fecal debris. The tape is then placed, the sticky side down, on a slide and examined microscopically.

ARTHROPODA

The other branch of animals which will be particularly discussed in this section is the phylum Arthropoda. From a medical standpoint interest centers in two classes only—the arachnids and the insects. They affect man by:

1. Transmitting disease organisms.
2. Invading the tissues of man.
3. Inoculating poisonous substances.
4. Being pests of man.

Arachnida. This class includes spiders, mites, and ticks. The adults have four pairs of legs and two body regions.

The tick family of arachnids is of great and increasing medical importance. They are proven vectors (transmitters) of:

Spirochaetes (various relapsing fevers in North Central and South America, Africa, and Asia Minor).

Bacteria (tularemia in many parts of the world).

Ova of Helminths

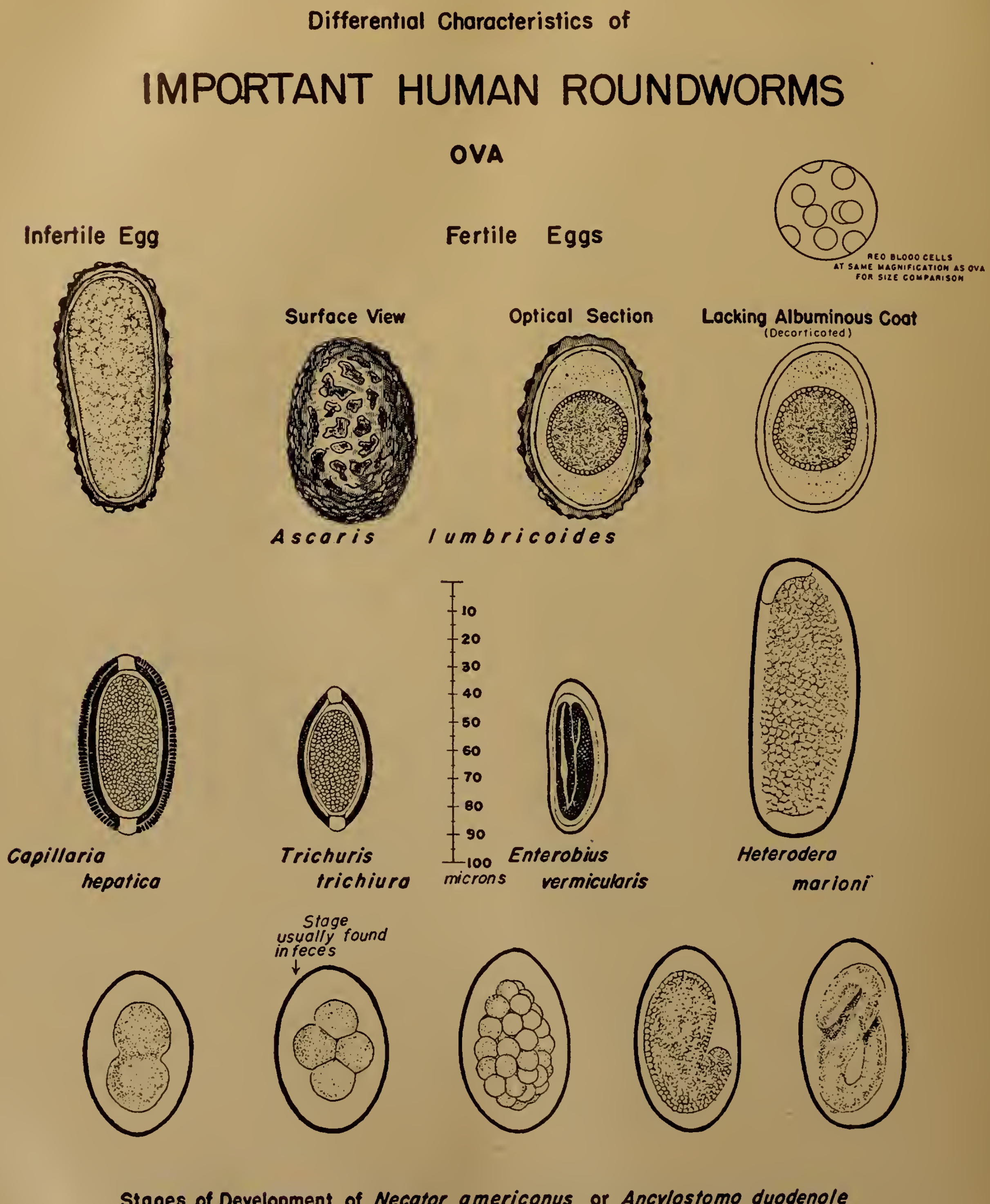


Figure 393.—Some Ova of the Common Parasites of Man.

Rickettsias (spotted fever, Q fever, Boutonnuese fever, South African tick-bite fever and Colorado tick fever).

Viruses (St. Louis encephalitis, Bullis fever, and Russian Spring-summer encephalitis).

Ticks also cause a peculiar paralysis by their bite alone.

Ticks are much larger than most mites, and are easily seen with the unaided eye. They are all parasitic on vertebrates, and most abundant on mammals and reptiles. Their food consists entirely of blood and lymph sucked from their host. Their life cycles differ greatly in length of time required for development and the number of hosts.

Mites include some of the smallest arthropods and are often microscopical in size. They are of medical importance because they invade tissues (scabies), are pests (chiggers), and most important of all carry several human diseases (scrub typhus, St. Louis encephalitis, and rickettsial pox). Several of the repellents now on the supply table are effective against both mites and ticks. They may be applied directly to the skin or to the clothing. Treated clothing often repells arthropods for weeks under certain conditions, whereas the same material applied to the skin may be effective for only a matter of hours.

Of the spiders, the black widow, or hourglass spider, is the most important. This species may be recognized by its shiny black body and legs, with a red hourglasslike spot on the under side of the abdomen. Occasionally there may be a row of red spots on the under side. The black widow spider is commonly found in outbuildings, piles of lumber and bricks on the ground, or under tarpaulins. About 30 minutes after the bite, excruciating pains are felt in various parts of the body, particularly in the abdomen, with marked rigidity of the muscles. Intravenous calcium, either gluconate or lactate, at the rate of 0.2 cc. Kg. body weight, is recommended for its diagnostic as well as its therapeutic value.

Insecta

To this class belong the insects. They may be recognized from the other arthropods by their three pairs of legs, their three body regions, and one pair of antennae. Those of the greatest medical importance are the fleas, lice, assasin bugs, flies, and mosquitoes.

The mosquitoes are of great medical importance due to the part they play in the transmission of such diseases as yellow fever, malaria, dengue, and filariasis. In addition to their ability to transmit disease they can cause lost man-hours by appearing in large swarms, making outside work almost impossible. Mosquitoes lay their eggs in or near the water, so that emerging larvae, often called "wigglers," can reach water readily. While living in the water they can often be killed by larvacides such as fuel oil, oil and DDT, or dusts containing insecticides. The adult mosquitoes that survive can be killed by aerosol bombs, insecticide films on screens and bulkheads, or an ordinary fly swatter.

Sometimes it is not possible to kill all insect pests in certain areas—such as combat zones and foreign cities. To keep insects from biting under such conditions, personnel are instructed to use repellent clothing and skin repellents. All of these measures (insecticides, repellents, and screens) are used to keep mosquitoes from biting man, and thus stop the spread of disease.

Fleas are small, flat, brown insects that are able to transmit plague and murine typhus. Plague is an old and dreaded disease which kills rats as well as men. Fleas carry the bacilli from rodent to rodent usually, but often suck human blood if available. Effective flea control begins with rodent control—ratproofing and poisoning their food. The known rat "runs" should be dusted heavily with insecticides at the same time, so that both rats and their fleas are killed.

The lice that are most often found on man are of three types—the crab louse, the body louse and the head louse. The head and body louse are very nearly the same in appearance, and affect man in two ways—through the direct effect of their bites and by the transmission of disease organisms.

The bites affect most people by producing small red spots from the waist upwards, accompanied by an intense itching, leading to scratching and often to secondary infections. After long exposure to lice the skin becomes roughened and thickened producing what is known as "vagabond's disease." Loss of sleep, irritability, restlessness and sometimes an anemic condition may result.

The principal human diseases transmitted by lice are: (a) epidemic typhus; (b) trench fever;

and (c) relapsing fever. Naval personnel may bring lice back to their quarters on clothing or on their bodies. It is very important to report such infestations promptly and to begin delousing immediately, for lice reproduce rapidly and many persons may be infested within a week's time.

Delousing the individual consists of bathing and the application of louse powder to hairy portions of the body. Clothing is often fumigated while the person is bathing.

Flies affect many by carrying pathogenic organisms, sucking blood and invading various tissues. Blood-sucking flies may carry such diseases as filariasis, tularemia, pappataci fever and sleeping sickness. Filth flies do not have mouthparts adopted for sucking blood, but they are equally dangerous due to their filthy habits.

The house fly is found in many parts of the world, wherever filth occurs. They are able to carry disease organisms on their feet, mouth parts, and body bristles in their regurgitated food (vomit spots), or in their feces. They are proven vectors of over 20 different diseases.

Maggots are immature flies in the larval stage. When these infest animal or human tissue the condition is known as myiasis. Eggs may be laid on food or near the body openings (ears, nose, mouth, or anus). When the maggots leave the egg and feed on internal tissues, serious complications may result, occasionally ending in death.

Control of flies is accomplished mainly through elimination of their breeding grounds in and near Navy establishments. With proper waste and sewage disposal, screened buildings, and limited use of insecticides flyborne diseases can be kept at a minimum.

SEROLOGY

Kahn Test for Syphilis

This test is a precipitation or flocculation test used to substantiate or rule out a diagnosis of syphilis.

The test is based upon the ability of the antigens used to detect the presence of an antibodylike substance known as reagin. The term syphilitic reagin is used to designate the antibodies that result from an infection by Treponema pallidum. These antibodies are specific and are detectable by the various serodiagnostic precipitation tests because the antibodies or reagins produce changes in the dispersion of the antigen lipids. These changes are manifested by the formation of visible aggregates, the sizes of which are roughly proportional to the amount of reagin present.

There are five Kahn procedures, but the two generally used are the routine test with serum and the qualitative spinal-fluid procedure. The former is used for general diagnosis and as a check on the specific treatment; the later is used for diagnosis of neurosyphilis and as a check on its treatment. The remaining tests are:

1. The qualitative test with serum and with spinal fluid used in following the progress of treated cases.

2. The presumptive procedure which is a one tube test used to eliminate lues as a diagnosis and as a check on the routine test.

3. The microscopic modification test is used when the amount of serum is too small for the routine test.

Antigen—Care

This antigen is employed in the performance of the standard (diagnostic) tests with serum and spinal fluid, in the quantitative tests with serum and spinal fluid, and in micro-tests and verification procedures. Kahn standard antigen is an antigen which has been standardized to a degree of specificity and sensitivity required for standard Kahn tests. The bringing of each lot of antigen to the required standard is of first importance for correct results and each lot of Kahn antigen manufactured and standardized at the U. S. Naval Medical School is checked and rechecked by Dr. Kahn's laboratory also. Standard antigen maintains the same titer for many years and remains uniform in specificity and sensitivity provided the following precautions are taken:

1. Only chemically clean and dry glass vessels should be used for storing antigen and these should be properly stoppered.

2. Antigen should be kept at room temperature—never in the ice box nor in the incubator. It should be stored in the dark—for example, a cupboard. The antigen bottle in daily use might be kept in a mailing container to avoid undue exposure to light.

3. Antigen should not come in contact with rubber or cork as both contain alcohol-soluble elements which affect specificity. Such stopper should be covered with high grade tinfoil.

4. If there is the slightest indication that the antigen has undergone a change, it should be returned to the U. S. Naval Medical Supply Depot with a full explanation of the facts.

Serum Care

1. It is essential that the serum employed in the test be entirely free from cells or particles of any kind, since these may give the impression of a precipitate in the completed test.

2. It is important to adhere to sterile technique in obtaining blood from patients. The tube into which the blood is emptied must be chemically clean and dry. Sterility of the tube is desirable but not essential, except where the specimen is to be shipped and several days intervene before examination. If the tube is agitated before a clot is formed, this tendency is greatly reduced.

3. It is well to break up the clot with wooden applicators before centrifugation. The inner wall of the tube is encircled with the applicators to separate completely the adhering blood clot. If the clot is contracted, it may be removed before centrifugation. The same applicators should never be used for more than one specimen of blood.

4. Ten to fifteen minutes centrifugation at 2,000 revolutions per minute is usually sufficient for the separation of the serum from the clot. If serum is not absolutely clear, it should be recentrifuged.

5. The clear supernatant serum is either poured off into a clean tube or is pipetted off with a serum-transfer, bulb-capillary pipette. The same serum-transfer, bulb-capillary pipette should never be used for more than one specimen until it is recleaned.

6. The clear serum should be heated (inactivated) for 30 minutes in a water bath at a temperature of 56° C. before performing the standard test. The temperature should not be 54° or 57° C., but exactly 56° C.

7. Serums should be tested as soon as possible after being heated. For uniformity it is well to begin the performance of the tests within about 10 minutes after the serums have been removed from the 56° C. water bath. Serums that have been heated 2 to 24 hours previously should be reheated for 10 minutes at 56° C. when they are to be reexamined; if after 24 hours, they should be reheated for 15 minutes.

8. Serums showing some hemolysis or containing chyle or bile do not affect the correctness of Kahn results. But if they are markedly hemolyzed or decomposed because of bacterial contamination, they are not fit for serologic tests.

Kahn Saline for Test

The saline solution consists of 0.9 percent sodium chloride (reagent quality for biological work) in distilled water. This sodium chloride must be chemically pure and of reagent quality. Sodium chloride of inferior quality (such as saline tablets) must not be used in the Kahn tests. Aboard ship, C. P. Sodium Chloride tablets for intravenous use may be used if no other C. P. Sodium Chloride is available.

Standard (Diagnostic) Test With Serum

The standard test is a three-tube test, each containing a different proportion of serum to antigen suspension. Optimum precipitation is obtained when the concentration of antigen and antibody (reagin) approximate one another. Hence a relatively large, moderate, and a small quantity of antigen suspension is employed with each serum, since the serum may contain a large, moderate, or small amount of antibody. Then again the use of three proportions of serum to antigen suspension makes it possible to obtain highly sensitive precipitation results with standard antigen which is of moderate sensitivity but of high specificity.

The following outline presents the general plan of the Standard Kahn Reaction, giving four different ranges in precipitation:

	Tube 1	Tube 2	Tube 3
Serum-antigen suspension ratio	3:1	6:1	12:1
Antigen suspension, cc	0.05	0.025	0.0125
Serum, cc	0.15	0.15	0.15
Illustrative types of precipitation reactions:			
Negative in the three proportions	–	–	–
Positive in the three proportions	++++	++++	++++
Positive only with the small amounts of antigen suspension	–	++	++++
Positive only with the larger amounts of antigen suspension	++++	++	–

1. **Preparations for test.**—Set up the number of Kahn racks required.

Number the tubes (13×75 mm.) to conform with the serum tubes and place in racks.

Lay out the necessary number and type of pipettes.

Plan on performing only that number of tests than can be performed within a 20-minute period; this will usually be about 40 standard tests.

2. **Heating of serum.**—Heat serum in water bath for 30 minutes at exactly 56° C.

Following heating of serum, examine for particles and if present, clear by recentrifugation.

3. **Preparation of standard antigen suspension.**—Two dry chemically clean antigen suspension vials will be required. (55 mm.×15 mm.)

Into one suspension vial measure the amount of saline solution required according to the titer shown on the antigen bottle. Use a 1-cc. or 2-cc. pipette.

With a chemically clean pipette measure 1 cc. of the antigen into a similar vial.

The salt solution is now poured into the antigen, and as rapidly as possible (without waiting to drain the vial) the mixture is poured back and forth a total of 12 times to ensure thorough mixing.

Allow the suspension to stand 10 minutes before using.

The suspension is not to be used after standing 30 minutes from the time of mixing.

Do not mix a previously prepared suspension with a newly mixed suspension.

Amounts of antigen of less than 1 cc. or more than 3 cc.'s should not be used.

4. **Measuring antigen suspension.**—Using the 0.25-cc. pipette, deliver the antigen suspension to the bottom of the tubes in the test tube rack as follows:

Pipette 0.05 cc. into the tubes in the first row.

Pipette 0.025 cc. into the tubes in the second row.

Pipette 0.0125 cc. into the tubes in the third row.

Do not use a pipette with a broken tip.

Pipette antigen suspension to one rack at a time; this is to be followed at once by the serum.

5. **Measuring serum.**—Serum is to be added as soon as possible after the antigen suspension has been pipetted to avoid undue evaporation of the suspension.

Use a clean dry pipette for each serum. (1-cc. pipette)

Each serum in the amounts of 0.15 cc. is added to the 0.05, 0.025, and 0.0125 cc. amounts of antigen suspension, and the rack of tubes is shaken vigorously for 10 seconds to ensure thorough mixing of the ingredients.

Let serum-antigen mixtures stand for about 5 to 7 minutes at room temperature.

The tests are now shaken for 3 minutes in a standard shaking machine or by hand.

6. **Addition of salt solution.**—Using a clean dry 10 cc. pipette, add, after the serum-antigen mixtures have stood 3 minutes, 1 cc. amounts of the saline solution to the front row of tubes (containing the 0.05 cc. amounts of antigen-serum mixtures) and 0.5 cc. amounts of saline solution to the two remaining rows.

Shake by hand sufficiently to mix.

7. **Reading results.**—Slant tube and hold over concave mirror of the microscope, using the microscope lamp for illumination.

Presence of a definite precipitate in a clear fluid is a four plus (++++). Grade readings on a basis of one to four plus.

The final average is the average of the readings of the three tubes.

Negative and positive controls should be set up for checking serums being run as well as a saline control.

Positive findings should be checked for presence of red cells and foreign particles. When in doubt of results for any reason, repeat test. Figure 394 illustrates serological pipettes, markings and holding technique for delivery of fluids.

Figures 395 and 396 illustrate the basic steps used in the Kahn test procedure. These steps are applicable to either the standard or the presumptive test.

Presumptive Kahn Test

The presumptive test is an auxiliary method to the standard Kahn test. The main difference between the two tests is that the presumptive is more sensitive than the standard test. This increased sensitivity is due to the fact that in the presump-

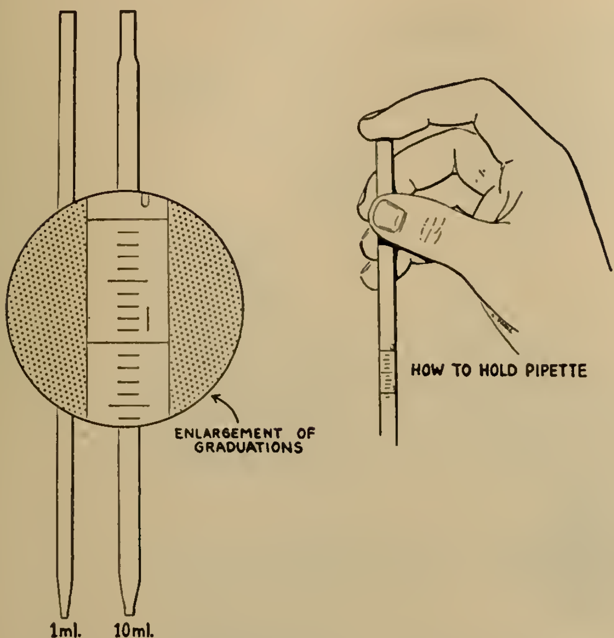


Figure 394.—Serological Pipettes and Holding Technique.

tive test, sensitized antigen is employed which is more sensitive than standard antigen. A negative reaction with this test is "presumptive" evidence that syphilitic reagin is not present and the conclusion that syphilis is not present in the patient: this test can be relied upon with an extremely small margin of error Every serum that shows any reaction whatsoever by the Kahn presumptive test must be checked by the Kahn standard (diagnostic) test.

1. **Preparation of antigen suspension.**—Antigen suspension is prepared in the same manner as for standard Kahn test with the exception that the bottle marked PRESUMPTIVE TESTS is used.

2. **Measuring antigen suspension.**—Measure 0.025 cc. of the thoroughly mixed antigen suspension into a standard tube (75 mm.×13 mm.), delivering the suspension to the bottom of the tube.

3. **Measuring serum.**—Add 0.15 cc. serum after heating for 30 minutes at 56° C., and mix serum with the antigen suspension by shaking the rack vigorously by hand for about 10 seconds.

Let rack stand 3 to 5 minutes.

Shake in the usual manner for 3 minutes in a standard shaking machine or by hand.

4. **Addition of salt solution.**—Add 0.5 cc. physiologic salt solution to the tube, mix, and immediately examine for the presence of flocculation.

5. **Reading results.**—Results are read in the same manner as the standard Kahn test.

Complete precipitation (four or three plus) is interpreted as positive.

Moderate precipitation reaction (two plus) is interpreted as doubtful.

Tubes showing no reaction are negative.

Any serum showing reaction of any degree by the presumptive Kahn test must be checked by the Kahn standard (diagnostic) test.

6. **Negative, positive, and saline controls** should be set up to check results of the serum being tested.

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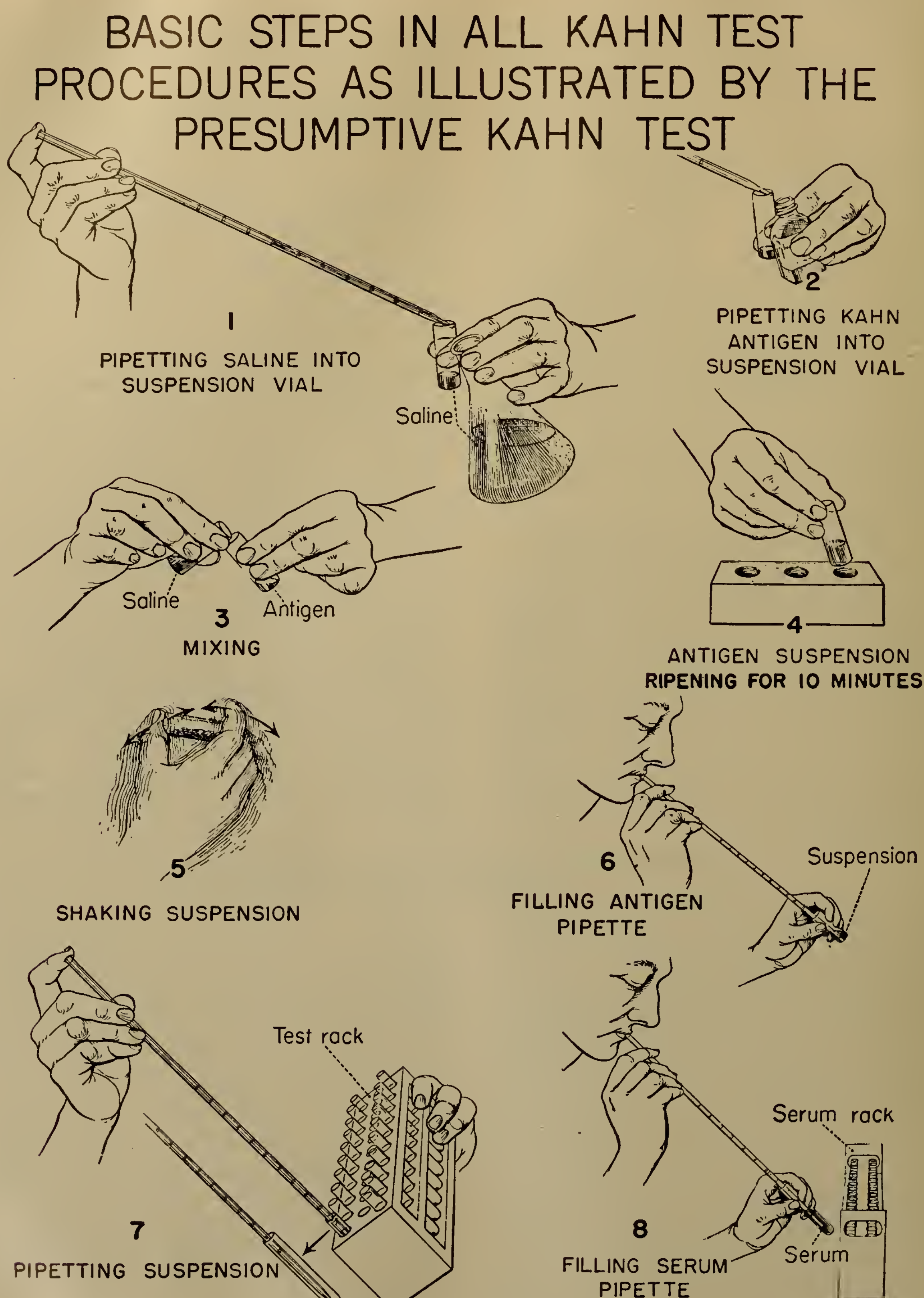

Figure 395.—The Basic Steps in the Kahn Test Procedure.

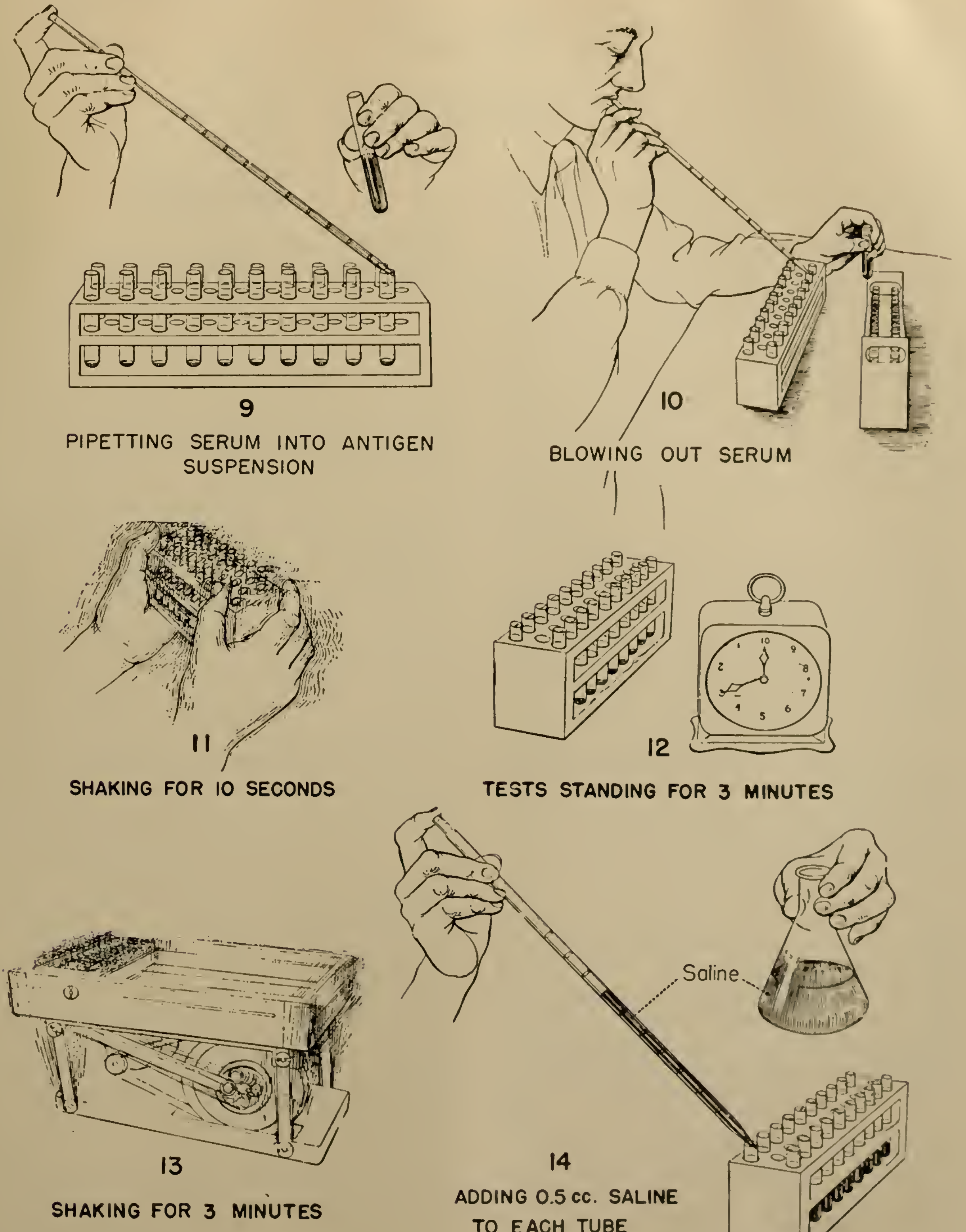

Figure 396.—The Basic Steps in the Kahn Test Procedure.

Chapter XI

EMBALMING

INTRODUCTION

Embalming is the art of preserving bodies after death. The primary purposes for embalming are: (1) Preservation of remains; (2) sanitation; and (3) restoration of lifelike appearance.

All members of the Hospital Corps should be familiar with the procedures employed in embalming the bodies of the dead and with preparing the remains for interment and for shipment. Reference should be made to Chapter 17, Manual of the Medical Department, U. S. Navy, for full information regarding deaths and the care of the dead.

All bodies prepared for interment or shipment under the supervision of naval medical officers shall be thoroughly and completely embalmed in the manner described hereafter, using the embalming fluid as prescribed. If the embalming is done in the United States by a licensed embalmer, he may be permitted to use the standard embalming fluid with which he is familiar.

All navy embalmers must exercise great care in the preservation of bodies and their preparation for the casket, so that they may reach relatives showing evidence of respectful and careful handling, without signs of decomposition, and with the natural appearance preserved.

Shaving and modeling of the features should be completed before the injection is begun. The face and hands should be liberally anointed and carefully massaged with an ointment made of petrolatum in which 10 percent each of eugenol and thymol are thoroughly incorporated. This ointment prevents drying and tends to prevent the growth of molds on exposed skin, an important factor in preserving the natural appearance of the face and hands. Any excess ointment should be removed.

The formula for embalming fluid to be used is:

Liquid formaldehyde (U. S. P. solution formaldehyde)	13.5 cc
Sodium borate (borax)	5.0 gm
Glycerin (optional)	5.0 cc
Water, sufficient to make	100.0 cc

Should the solution of formaldehyde contain less than 37 percent of formaldehyde gas, the amount used should be increased proportionately. The addition of ethyl alcohol in the proportion of 10 percent of the amount of the liquids in the formula aids in the solution of the sodium borate and to some extent in preventing "graying" of the skin.

As this solution is irritating to live skin, rubber gloves should be worn while embalming. Anointing the hands well with a heavy ointment aids in preventing irritation, but the wearing of gloves is preferable.

The exact composition of an embalming fluid is of less importance than the method of injection, but service embalmers who may be acquainted with civilian practice and inclined to follow it should remember that methods which have proved equal to preserving remains for a few days in temperate regions may be entirely inadequate to preserve bodies for months in the tropics.

The fluid represented by the formula quoted (Francis) will retain stability for more than 2½ years; it has proved effective in preserving human subjects exposed for 2 months to a temperature of 98 degrees F. This formula is to be used in all cases.

The fluid hardens tissues so rapidly that thorough penetration to more remote parts is often hindered. For this reason the whole procedure should be carried out rapidly. When only one injection is used, the injection should be started with half-strength solution. When the return flow through the drainage tube has been established, the full-strength solution should then be used.

The pressure essential to successful injection may be obtained either by elevating the container to a height of 6 feet or by means of a continuous flow rubber bulb syringe. If a pump is used the pumping must be slow in order to avoid rupturing

blood vessels. Do not attempt to force or hurry the flow of embalming fluid. A slow penetration by gravity with minimum pressure gives better results and preserves the natural appearance much better.

PREPARATION OF THE BODY FOR EMBALMING

After the body has been placed upon the operating table, it should be carefully bathed; the embalmer should use plenty of soap and water. The hair should be washed and the fingernails should be carefully cleaned. If the subject is an adult male, lather should be applied to the face and a little massage cream rubbed into the lather before the face is shaved. The cream serves two purposes. It makes the beard cut more easily and also has a tendency to prevent razor burns with close shaving.

The fixing of the features is one of the most important parts of the preparation. The mouth and eyes should be closed in a natural manner, so as to approach as near a normal expression as possible of the individual when in health or repose.

Closing the Mouth

To make a mouth closure, use a large, strong, half-curved needle inserted back of the lower incisors next to the mandible bone, bringing the needle out through the skin under the chin as close to the bone as possible. Insert the point of the needle in the same hole and direct the needle upward on the outside of the mandible between the lips and the teeth. Then, with the same long thread or a separate thread, insert the needle under the upper lip, bringing the point out through one of the nostrils. Draw the needle through and insert it through the septum of the nostrils, and down between the teeth and the upper lip and tie firmly. (See fig. 397.)

Before the mouth is closed, the lips should be thoroughly covered both inside and outside with a massage cream or petrolatum. This serves the purpose of holding the lips together and prevents fluid burns should a long purge develop during the injection.

Figure 397.—Closing the Mouth.

Closing the Eyes

The expression of the face in death is as much dependent upon the eyes as upon the mouth. The eye closure should be as nearly as possible the closure in natural slumber. A point to be remembered at this time is that no one has ever been found sleeping with the upper eyelid overlapping the lower one; also when the eyelids are closed naturally, they do not meet across the center of the eyeball. The upper lid extends downward, past the center of the eyeball, giving the upper lid the appearance of being twice as long up and down as the lower lid. In death the eyeball has a tendency to sink somewhat and flatten; therefore never wash the eyeballs off with embalming fluid or use a cotton pledget saturated with embalming fluid, as there will be difficulty with the eyelids separating and turning brown along the edges.

The proper method of rounding out the contour of the lids is to place a very thin pledget of dry cotton under the lids before they are closed. This pledget is prepared by taking a thin layer of cotton between the thumb and index finger and holding it in position, pulling out the edges so as to form a thin circular pledget about as large as a five-cent piece.

This pledget is then grasped with a spring forceps. One edge of the pledget is inserted under the lower eyelid. The lower lid is pulled slightly up over the cotton. Massage cream or petrolatum should be applied to the outer edges of both upper and lower lids, after which the upper lid is raised with an aneurism needle and the upper part of the

cotton pushed up under the upper lid by means of the flat end of the forceps.

Leaving the flat part of the forceps under the upper lid, place the index finger above the lid and the forceps and pull the upper lid down to meet the lower one. The edges of the lids are then gently pushed together. The cream that has been applied will serve two purposes. It will hold the lids together until the chemical reaction of the embalming fluid is sufficient to do so and will prevent drying and browning of the edges of the eyelids.

After the features have been fixed, the entire face should be covered with an application of massage cream, cold cream, or petrolatum. The purpose of this cream is to prevent fluid burns, to seal the pores of the skin, and prevent excessive drying. It should not be washed off after embalming but merely wiped off, leaving the pores filled. This not only prevents overdehydration but will keep the skin velvety and form a splendid base for cosmetic application.

Position of the Body

After the body has been prepared, the proper placing of the body on the table is very important, keeping in mind the appearance it will present in the casket. The head rest should be arranged so that there is no pressure on the back of the neck, pressure may give the neck a swollen appearance and is likely to interfere somewhat with the circulation of the fluid. The head should be straight and in line, not turned or twisted, and should be in the position that it is to assume when placed in the casket. (See fig. 398.)

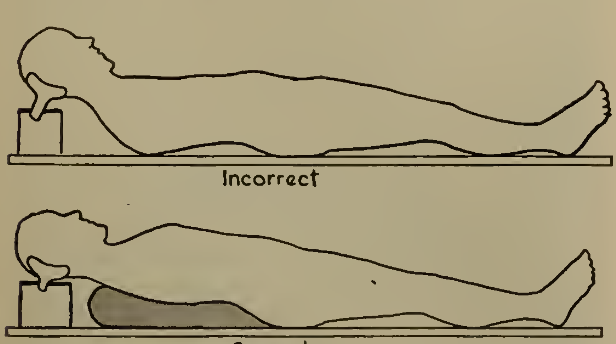

Figure 398.—Correct Position for Placing Body on Table.

Raising Vessels for Embalming

There are a number of locations on the body where arteries and veins may be raised for the embalming operation. The vessels selected depend upon the cause of death and the general condition of the body to be embalmed. Quite commonly it is necessary to raise only one artery for injection and one vein for drainage. At times, it may be necessary to raise a number of arteries and veins. The vein selected is usually the one accompanying the artery selected.

It is necessary that the embalmer be thoroughly familiar with the location of the vessels and the points at which they may be raised most easily. A thorough knowledge of the linear guides will facilitate the operation of raising vessels. The ones the embalmer is most concerned with are as follows:

1. The linear guide for the axillary artery and the axillary vein will be an imaginary line through the center of the axillary space along the anterior margin of the hair line when the arm is extended at right angles to the body and the palm of the hand is turned upward.

2. The linear guide for the common carotid artery and the internal jugular vein will be an imaginary line extending from the sternoclavicular articulation to a point midway between the angle of the jaw and the mastoid process.

3. The linear guide for the femoral artery and the femoral vein will be an imaginary line drawn from the center of Poupart's ligament to the apex of Scarpa's triangle. An easy way to find this line is to place the thumb on the crest of the ilium and the middle finger on the crest of the pubic arch, pointing the index finger toward the middle of the knee with the foot turned outward. In this position of the hand, the line mentioned will lie directly under the index finger.

4 The linear guide for the brachial artery and the basilic vein is an imaginary line drawn from the center of the axillary space to the middle of the elbow. Anatomically these vessels lie along the inner border of the biceps muscle.

5. The linear guide for the radial artery is a line drawn from the center of the bend of the elbow to the center of the ball of the thumb.

The Axillary

The arms of the subject should be held at right angles to the body with the palm of the hand turned upward. Make the incision through the skin along the anterior border of the hair line in the arm pit. The superficial fascia should be dissected carefully to avoid rupture of the veins. The incision should be about one and a half to two inches in length on the outside. It may be made longer under the skin.

If the wound is held open, the vein will be readily seen because it will be engorged with blood. The nerve will also be seen. The artery lies behind the nerve and may be easily raised by placing an aneurism needle under the nerve and pulling it aside, thus disclosing the artery. By placing the aneurism needle under the artery, it may be easily raised to the surface of the incision and may be held there by placing a bone separator under it. Place two threads about 6 inches long under the artery about 1 inch apart. Tie these loosely with a surgeon's knot. Then make the incision in the artery and insert the arterial tubes, one toward the heart and one away from the heart and draw the threads tight Then raise the axilliary vein in the same manner and insert a drainage tube toward the heart. The drainage tube used should be small enough to enter the vein easily. Application of massage cream or petrolatum to the tube before inserting will be of considerable assistance.

The axillary drain tube should not be inserted too far as there is a possibility of blocking drainage from the internal jugular vein on the side from which the operation is being performed. When a person is embalming from the right side of the body and when the right axillary vein is used for drainage, it will be noted that the left side of the face clears but that the right side does not. Generally this is caused by inserting the drainage tube too far and passing it through the subclavian into the innominate vein. When this condition is noted, the tube should be partially withdrawn immediately.

When the axillary artery and vein are used, it is a good plan to inject the arm downward first: then inject toward the heart for the rest of the injection. It is not necessary to insert the drainage tube toward the hand at any time as the collateral drainage will take care of this part. It is, however, necessary to inject toward the hand as there will not be sufficient supply of fluid through the collateral circulation to force the blood from the arm and hand and thoroughly preserve them.

The Common Carotid

The common carotid artery and internal jugular vein can be raised by the embalmer's making an incision along the upper border of the clavicle bone, beginning near the juncture of the clavicle and the sternum and extending along the upper border of the clavicle about two inches toward the side on which the operator is standing. After the skin has been incised, cut through the platysma muscle (muscle of the neck), which will reveal the aperture between the sternal head and the clavicular head of the sternocleidomastoid muscle. Separate the fascia and push the muscles to one side and the vessels will be seen, the vein lying to the outside and the artery to the inside enclosed in a sheath. (See fig. 399.) Carefully dissect through the sheath and raise the vessels in the same manner explained previously for the axillary artery and vein. It will be found much easier to raise these vessels with the head resting on the table with the face turned away from the operator.

These vessels may also be raised by making the incision back of the lower third of the sterno-

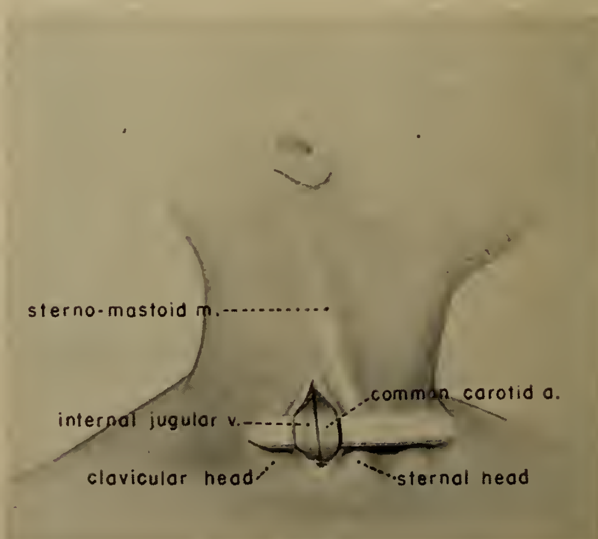

Figure 399.—The Common Carotid Artery and the Internal Jugular Vein Raised.

cleidomastoid muscle. When the incision is made at this point, it is perhaps easier to insert the drain tube toward the heart. This incision also has the advantage of being easier to conceal when the head is slightly turned toward the side on which the incision has been made.

When the common carotid artery is used for injection and the internal jugular vein is used for drainage, it is well to inject upward at the beginning of the operation; then, after that side of the face has cleared properly and received sufficient fluid, turn the tube downward toward the heart and complete the injection with the tube in that position. The drainage tube, as in operations from any other point, is directed toward the heart. Never tie the jugular vein above the point of insertion of the drainage tube until the embalming operation has been completed. The opening is needed for drainage from that side of the face.

The Femoral

To raise the femoral artery and vein, the embalmer should begin the incision at the lower border of Poupart's ligament and extend it for 2 inches downward along the linear guide. Dissect through the superficial fascia and the superficial lymphatic glands and raise the artery and vein by the methods previously described for the axillary. (See fig. 400.)

Brachial Artery and Basilic Vein

The arm of the subject should be held at right angles to the body with the palm of the hand turned upward. Make the incision along the linear guide, at the center of the indentation between the biceps and the internal head of the triceps muscles. Separate the superficial fascia carefully to avoid rupture of vessels. The artery and vein will be easily recognized in the same manner as the axillary. (See fig. 401.) The basilic vein will be gorged with blood and the brachial artery will be located behind and between the nerves in the same sheath. Raise the artery and vein by the same method as previously described for the axillary.

The Radial Artery

This artery is very seldom used but there may be occasions when it is to be used in order to get sufficient fluid to the hands. It has been found that there are times when it is impossible to get a thorough circulation to the arm by means of the axillary, but that by injecting upward through the radial, a sufficient degree of saturation may be brought about to preserve the arm. This artery is very superficial and can be raised very readily by making a small incision along the linear guide about two inches above the wrist joint. After the skin and fascia have been incised, the vessel will be exposed. There are no other arteries near enough to the radial artery to confuse the operator. Care should be taken when the radial artery is used, in injecting the hand, that too much pressure isn't used as the hand can be easily swollen out of proportion.

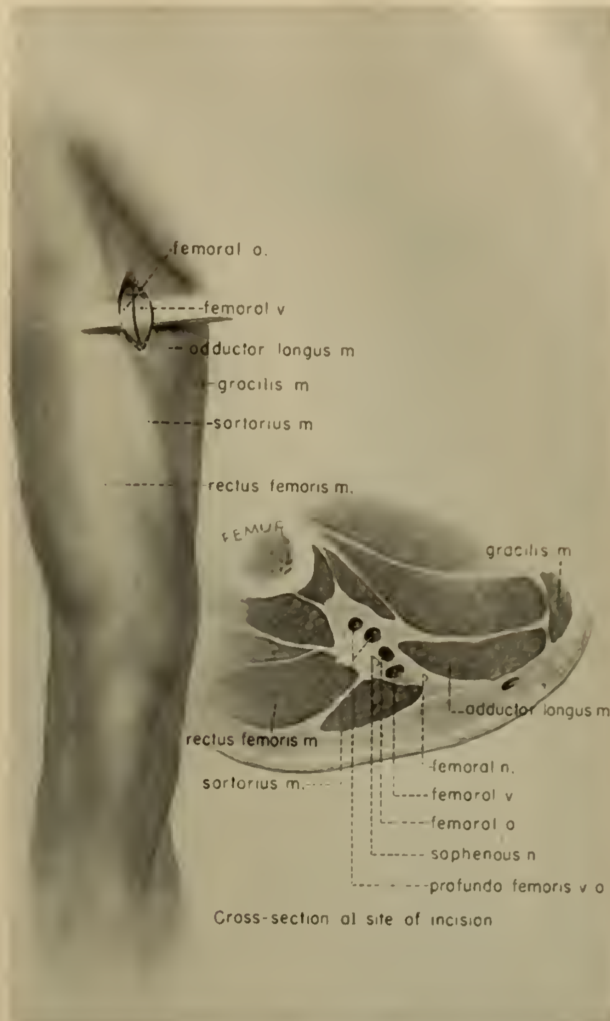

Figure 400.—The Femoral Artery and Vein Raised.

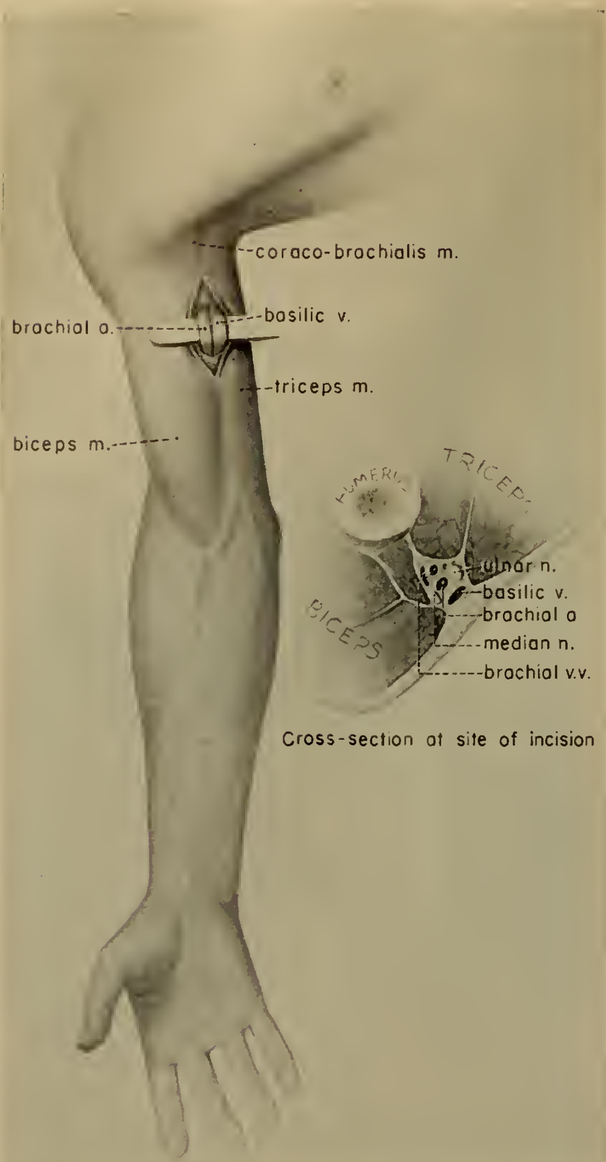

Figure 401.—The Brachial Artery and Basilic Vein Raised.

ARTERIAL INJECTION

To insure that a body is thoroughly embalmed, the embalmer must use both arterial and cavity injection. The technique of injection is very important because prolonged preservation depends upon the complete saturation of every tissue of the body with embalming fluid. If there is no break in the arterial and venous system, the body may be embalmed by raising only one artery and the adjacent vein. The most desirable ones are the axillary artery and vein, the brachial artery and basilic vein, and the femoral artery and vein.

After the artery and vein to be used are selected and raised, insert the arterial tubes and the drainage tube as directed in the paragraph describing the raising of the axillary artery and vein. Two arterial tubes are necessary for the injection and must be in both directions in order to preserve all parts. One must be toward the heart which will enable the operator to distribute the fluid to all parts of the body except the part from the break in the artery down. This will have to be injected separately Figure 402 illustrates insertion of arterial and drainage tubes.

Before the injection of the embalming fluid is commenced, it is advisable, when facilities are available, to first inject one of the following:

1. Two hundred to five hundred cc. of a warm physiological salt solution.

2. A 12 percent aqueous solution of sodium sulfate.

3. A 25 percent aqueous solution of magnesium sulfate.

Any one of the above solutions will aid drainage of the blood from the body by breaking up blood clots, dissolving thick blood, insuring complete

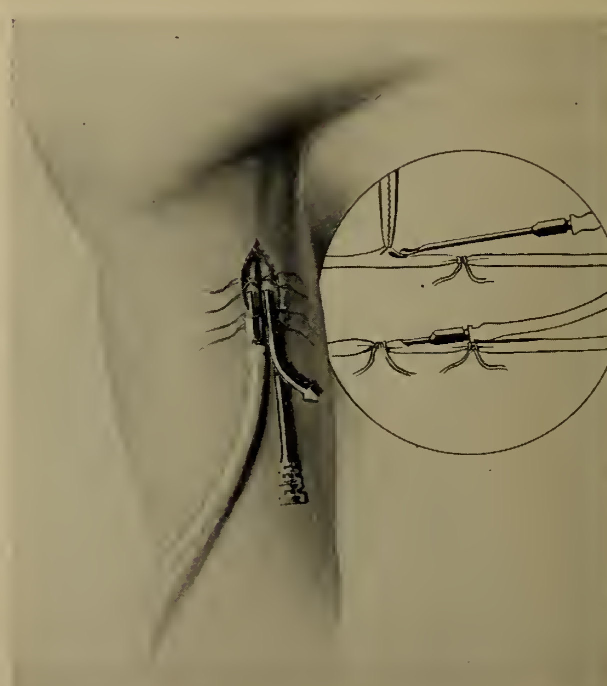

Figure 402.—Insertion of Arterial and Drainage Tubes.

saturation of all the tissues of the body with embalming fluid, and facilitating the flow of the fluid.

Thorough penetration is promoted by repeated flexion and extension of limbs and by gentle massage of soft parts with petrolatum or massage cream. Massage is the only satisfactory method of removing discoloration from soft parts. An advanced line of firmness of the tissues may be taken as an indication of the progress of the fluid. Raising the head and neck about 6 inches at the start of the injection will tend to prevent flooding of the face and will give a more equal penetration.

It is an easy matter to overinject: this will cause the face and hands to become puffy and unnatural. To avoid this, the operator should inject slowly and steadily with not too much pressure being exercised behind the fluid while injecting. Signs which may be accepted as indicating that sufficient fluid has been used, regardless of the amount injected, are:

1. The eyes, lips, or one side of the face become distended. In the case of an extremity, when it is apparent that the fluid has circulated from the smaller arteries through the capillaries into the veins, the veins will stand out as though a tourniquet were being applied.
2. The tissues of the region are uniformly firm with no "soft" areas remaining.
3. The embalming fluid that returns from the drainage tube is clear.

Overinjection, however, is not objectionable if a long time is to elapse before the remains are to be viewed because a slow shrinkage of the body takes place. This shrinkage or dehydration may be stimulated by sponging the entire body with alcohol several times each day after the embalming operation has been completed and before the remains are wrapped and placed in the casket for shipment.

Three injections are necessary for shipment of bodies prepared aboard ship outside the continental limits and on foreign shore bases and stations. If the body is to reach its final destination within a few days, one injection is all that is necessary.

Using the regular prescribed Navy embalming fluid, which has been discussed, the operator makes the following injections: First, an injection of one-quarter strength, followed 12 hours later with an injection of one-half strength; then, 36 hours after the first injection, one of full strength shall be used. The arterial and drainage tubes should remain inserted in the vessels until arterial injection has been completed. They may then be withdrawn and all vessels ligated to avoid any leakage of fluids.

In cases of injuries inflicted before death there may be breaks in the arterial and venous system; thus it is necessary to raise more than one artery and vein. In order to insure thorough penetration of the fluid and thorough preservation of the body, the operator should raise and inject all necessary arteries and veins. These have all been discussed previously, but it is well to discuss the injection via the carotid artery further because of its importance in the appearance of the face.

When it becomes necessary to use the carotid arteries for injection of the head, massage of the face and adjacent parts is necessary. It is especially necessary to make sure that the fluid reaches the less vascular parts, such as the tip of the nose and margins and lobes of the ears. Here, as elsewhere, palpable firmness of the tissues is an indication that sufficient fluid has reached the part. If any of these parts remain soft after completion of arterial injection and show signs of "skin slipping," fluid can be introduced by means of a hypodermic syringe, the point of the needle being inserted through the ear, hairline, nostril, or mouth, so that the puncture will not be noticeable. Soft areas on other parts of the body may also be taken care of hypodermically.

CAVITY INJECTION

Thorough embalming implies the securing of long-time preservation. The entire body must receive a complete saturation of a preservative chemical. The work of securing such results must be confined to a limited space of time. With these conditions governing the work, it is obvious that special treatment should be given the organs and materials found in the abdominal and thoracic cavities.

Some fluid from arterial injection reaches these organs; but since we are interested in the appearance as well as the preservation of the body, it is impracticable to use sufficient pressure back of the arterial injection to saturate these organs and their

contents. To do so would cause the body to swell and become distorted. Some of the fluid from the arterial injection may pass through the walls of the stomach and intestines into the fecal matter, but this amount would not be sufficient to render the contents of these organs sterile.

Occasionally, under favorable conditions, a body may "hold up" for "a couple of" days without cavity treatment, but this is rarely so. Actually the organs of the thoracic and abdominal cavities along with their contents constitute from 5 to 7 percent of the weight of the body. Since the contents of these hollow organs contain a great many decomposing organisms, these organs constitute the greatest danger or decomposition and putrefaction.

In doing cavity work, the embalmer must be sure that both the thoracic and the abdominal cavity receive proper treatment. There is always a possibility that purulent matter is in the pleural cavities. There may also be spots in the lungs where tissues have started to break down. It is always important to treat not only the pleural cavities but also the lungs internally with full strength embalming or cavity fluid. It is of great importance that a thorough aspiration of blood from the heart be made to avoid possible regurgitation of blood back through the jugular with resultant staining.

Insert the trocar at a point 2 inches above the umbilicus and 2 inches to the left of the median line. Continue the thrust until the trocar enters the stomach; then thoroughly aspirate the stomach. Before withdrawing the trocar from the stomach, inject several ounces of full-strength embalming fluid. This is the only manner in which the operator may be sure to get sufficient fluid into the stomach, because when the trocar is withdrawn the stomach will collapse. (See Fig. 403.)

Withdraw the trocar from the stomach and direct the point along an imaginary line drawn from the left hip bone to the lobe of the right ear; keep the point up against the cavity wall until it has pierced the diaphragm; then dip the point downward and thrust it into the heart. After the trocar has entered the heart, do not withdraw it, unless it becomes clogged, until you have withdrawn as much blood and fluid as possible. "Wriggling" the trocar from side to side and pressing over the heart with the hand will assist the

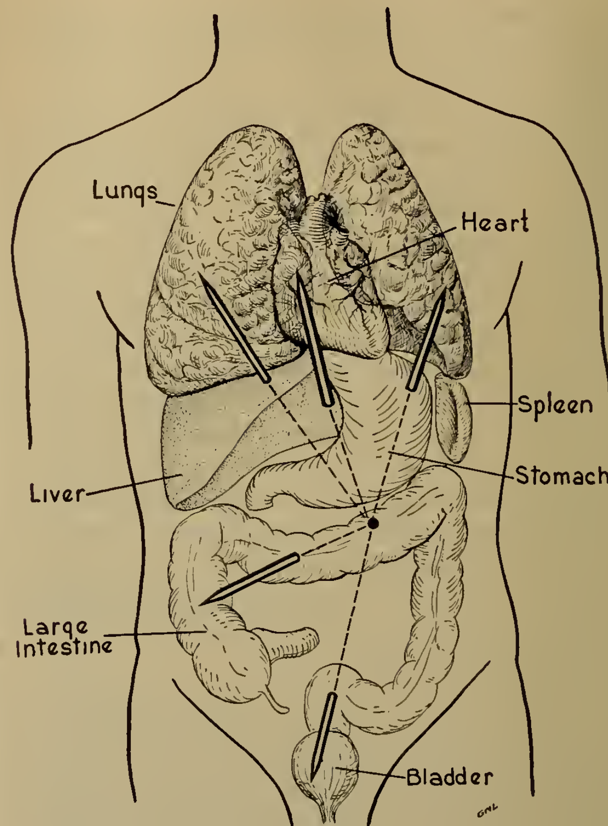

Figure 403.—Major Points for Aspiration and Cavity Injection.

operation. When the heart is completely aspirated, inject a sufficient amount of embalming fluid.

Partially withdraw the trocar and thoroughly aspirate the pleural cavities, at the same time piercing all parts of the lungs. Next direct the trocar point toward a point one-fourth of the distance from the hip bone to the pubic bone. Keep the point of the trocar well up near the abdominal wall until within 4 inches of the hip bone. Then dip the point of the trocar 2 inches and thrust it forward, piercing the colon or large intestines. After the trocar point is in this position, aspirate all the gases and materials possible. Pressure with the hand over the abdominal wall will enable the operator to pierce other parts of the intestinal tract. This aspiration should be as thorough as possible so that the abdominal wall presents a flat, somewhat sunken appearance.

Again partially withdraw the trocar; then direct the point toward the median line and the pubic bone, keeping the point up toward the abdominal

wall until the point touches the bone. Then withdraw about one-half inch, dip the point slightly and thrust it into the urinary bladder. Do not withdraw from the bladder until it has been emptied and several ounces of embalming fluid have been introduced.

After completion of thorough aspiration of both the abdominal and thoracic cavities, inject both cavities with sufficient fluid to saturate all parts. When the abdominal cavity appears slightly distended, it may be taken as a sign that sufficient fluid has been injected. Care must be taken so that all parts have received fluid. When time permits it is advisable to treat the cavities a second time approximately 24 hours after the first treatment.

When the cavities have been properly treated, the incision or point where the trocar was inserted should be closed. This is done by inserting a thread or suture into the skin around the trocar before withdrawing the instrument. This type of suture is known as the "purse string suture." After the trocar is withdrawn, pull both ends of the suture, closing the opening, and tie tightly with a surgical knot.

EMBALMING A POSTED BODY

The term "posted body" through long usage has come to have the accepted meaning of being a body in which the cavities have been opened for post mortem examination of the viscera. A complete "post" involves all the organs of the trunk cavity, the brain and occasionally sections of the spinal column. This will be found to be the case in the majority of bodies in the Navy.

To have easy access to the arteries, the medical officer performing the "post" should be requested to leave, if possible, the upper portions of the arch of the aorta. This will enable the person doing the embalming to have easy access to the innominate, right and left carotid, and right and left subclavian arteries. If the upper portion of the aorta cannot be left, then request that each of the above named arteries be tied and a strand of twine about 8 to 10 inches long be left hanging from the severed arteries. This will enable the embalmer to easily reach and find the arteries. It will not only aid in case of embalming, but will avoid possible mutilation of the neck in picking up the carotid. The same should be done with the arteries in the lower part of the abdomen. Having easy access to these arteries through the abdomen saves much time and effort and possible excessive loss of fluid into the abdominal cavity after injection is completed.

Before injecting a body on which a complete post has been performed, the embalmer must first prepare the head. This procedure is described as follows:

The floor of the cranial cavity should be cleansed thoroughly and the foramina (the opening through which the spinal cord passes from the cranial cavity to the spinal column) plugged with a piece of cotton, after which plaster of paris or another hardening compound should be used to fill the cavity to a point above the sawed line of the bone. It is well to leave a thin coat of plaster of paris to cover the sawed edges of the bone and to cement the calvarium or skull cap in place.

In order to make the skull cap immovable, the operator should drill four holes opposite each other just above the ear and two on each side of the head. Then take fine suture wire and secure the calvarium or skull cap in position. If the circular incision is made, a narrow strip of muslin saturated with embalming fluid and placed across the frontal bone carefully so as not to leave any wrinkles will eliminate the possibility of leaving a ridge across the forehead after the scalp has been pulled back in place. The scalp may then be sewed back in place with a "baseball stitch." Prepare the features in the same manner as in any other case before injection.

Now, operating from the thoracic cavity, place an arterial tube in each common carotid artery and inject the head slowly. When the face indicates that it has received a sufficient amount of fluid, stop the injection and remove the rubber tubing from the arterial tubes. Then, operating from the abdominal cavity, inject down in each one of the common iliac arteries and inject the legs. Inject both arms by way of the subclavian arteries. Do not remove the arterial tubes until after the final injection, for cases aboard ship or on a foreign station require three separate injections for preservation. Because of excessive drainage and leakage, posted bodies will require much more volume of injection than the same body would if normal.

After the head and limbs have been thoroughly embalmed, the trunk wall should be treated with full strength embalming fluid or formalin by means of a trocar. Insert the trocar into the muscular tissue between the skin and the bone, working from the trunk incision and inserting the trocar so that the point reaches well around the back.

Then, as the trocar is gradually withdrawn, inject fluid through it. The points of insertion in each wall should be along the incision between each rib and below the ribs at intervals of about 2 inches. The shoulders and heavy parts of the thighs should also receive this treatment. The gluteals can be reached by inserting the trocar through the obturator foramen.

After all injections have been completed, remove all arterial tubes and ligate all vessels. Remove all fluids which have accumulated in the thoracic and abdominal cavities and dry them out by wiping with gauze or other suitable material. Sprinkle a layer of hardening compound or plaster of paris in the bottom of the cavities. Fill the cavities with cotton and hardening compound by alternating one layer of cotton and then a layer of hardening compound. Each time cotton is used, saturate with full strength embalming fluid. Wrap the sternum in a piece of gauze saturated with embalming fluid and close the incision neatly with a tight baseball stitch.

PREPARATION AND ENCASEMENT OF THE BODY (AFTER EMBALMING)

Outside Continental Limits of the United States

After the embalming has been completed, after all blood vessels have been ligated, after all incisions have been properly closed, and after the proper time has elapsed for dehydration, the body can be prepared for encasement. This is accomplished by first applying a coat of 2 percent phenol ointment over the entire body. After this has been done, the embalmer will wrap the body with gauze, muslin, or surveyed linen and then impervious paper. The wrapping is to be secured in place by bandages so that there will be no exposed areas.

Before the wrapped but unclothed body is placed in the casket, the casket should be opened and exposed to the sun or artificial heat in order that the lining and padding may be free from moisture. The body is placed in the casket and the lining of the casket is fastened together over the body with straight pins. The pillow should be placed at the foot of the casket over the feet and legs. The casket is then placed in the shipping case. Clothing for the body should be dry, wrapped in impervious wax paper, and placed on top of and at the foot of the casket, inside the shipping case.

SPECIAL CASES

Communicable Diseases

In cases where death has been due to contagious disease, such as scarlet fever, smallpox, plague, Asiatic cholera, typhus fever or diphtheria, special precautionary measures must be taken.

The body should be bathed with a 1:1000 solution of Bichloride of Mercury, and all orifices must be packed with cotton saturated with a 1:500 solution of Bichloride of Mercury or full strength embalming fluid. Utmost care should be exercised by the embalmer in sterilizing the wastes withdrawn from the cavities by pumping them into a disinfectant solution before he disposes of them. He should also protect his hands with rubber gloves; after he has completed the embalming operation and before he removes the gloves from his hands, he should wash them in a disinfectant solution. A gown and head covering should be worn. These articles of clothing should be sterilized by boiling, steaming, or soaking in a disinfectant.

After the embalming has been completed and the remains have been washed, the embalmer must wrap the entire body with muslin or other suitable wrapping saturated with embalming fluid.

Death by Drowning

It is sometimes difficult to secure preservation of the bodies of drowned persons, especially when they have been in water for a long period of time. If a body has not been in the water too long, it may be embalmed the same as any normal case, with the exception that it is advisable to raise and inject four sets of arteries. These are the brachial, axillary, carotids, and the femorals.

Injection of the vascular trunks, injection with a trocar along the bones, and massive infiltration of the muscles and other portions of the body, using full strength formalin, will normally stop the formation of tissue gases and preserve the body.

The entire body is to be wrapped with muslin, sheeting, or other suitable material saturated with formalin and sealed.

Burns

Those cases having third-degree burns in which there is destruction of the skin and deeper tissues, may cause difficulty for the embalmer in securing proper preservation. The blood vessels themselves may be injured and thus retard circulation. It may be necessary to raise a number of arteries and veins in order to thoroughly inject such a body.

If the subject has survived for some length of time following the injury, there will likely be complications of pneumonia and general toxic condition; this tends to make removal of the blood difficult. There may be large areas of scabs with underlying pus formations.

In such cases, extensive scabs should be removed and a cotton pack of one-quarter strength embalming fluid, containing 10 percent of 95 percent ethyl alcohol, should be used. For example, where 50 percent of the body area has been burned, it would ordinarily take approximately 1000 cc. of embalming fluid of which 100 cc. will be ethyl alcohol. Place these packs over the exposed area. There may also be areas which, because of injuries to the blood vessels, will not receive the embalming fluid from the arterial injection. These should be treated very thoroughly with a hypodermic needle.

Most careful attention should be given to the cavities. Both the aspiration and injection of cavity fluid should be made in such a manner that every organ of the abdominal and thoracic cavities is explored with the trocar for possible pus pockets or dropsical effusions, and the amount of concentrated (full strength) fluid used should be sufficient to thoroughly saturate the organs.

An excellent hardening compound may be made by mixing equal parts by weight of dry sawdust, plaster of paris, and flake camphor.

SUMMARY OF PROCEDURES IN EMBALMING AND ENCASING A BODY

1. Place body on table, properly supported under the head and shoulders.

2. Bathe with soap and water. Hair and fingernails cleaned.

(NOTE.—This procedure must be varied if "post" has been performed).

3. Shave face if required. Care must be taken not to break skin or cause a burn on the face.

4. Close and fix eyelids and mouth as near "lifelike" as possible.

5. Cover face and hands well with petrolatum containing 10 percent each eugenol and thymol.

6. Arrange body on table in position it will assume when placed in casket. Make certain the head is centered and straight (fig. 398).

7. Make incision and raise selected arteries and veins. If circulation is unbroken, usually only one artery and vein is required.

8. Place two threads loosely on artery about 1 inch apart, make slit in artery, insert arterial tubes, one toward the heart, one away from the heart. Tighten threads (fig 402).

9. Place thread loosely on vein, make small slit and insert drainage tube toward heart (fig. 402).

10. If axillary or brachial artery is used inject fluid toward hand. Inject 2 to 3 ounces warm normal saline solution, followed by one-quarter strength embalming fluid.

11. Injection of fluid; slow, steady, with little pressure. Gentle massage of arm and hand will aid good distribution. Continue fluid until return flow through vein shows clear fluid.

12. Reverse injection toward heart. Inject 10 to 14 ounces warm saline solution followed by one-quarter strength embalming fluid. Use same procedure as outlined in paragraph 11, gently massage the extremities, ears, nose tip and other parts where there may be poor circulation.

13. Leave all tubes in place. After about 12 hours, repeat above procedure, using one-half strength fluid, omitting the saline solution.

14. Leave tubes in place. After 24 hours repeat above procedure, using full strength embalming fluid.

15. If time permits, fractional embalming should be used on all bodies. This will permit the massaging of puffy parts if there should be overinjection of any part. It permits better molding of features, especially after the first injection of one-quarter strength fluid. if remolding is necessary. It insures thorough embalming, and there should be pride in workmanship.

16. Immediately after first injection outlined in paragraphs 11 and 12, remove as much of the liq-

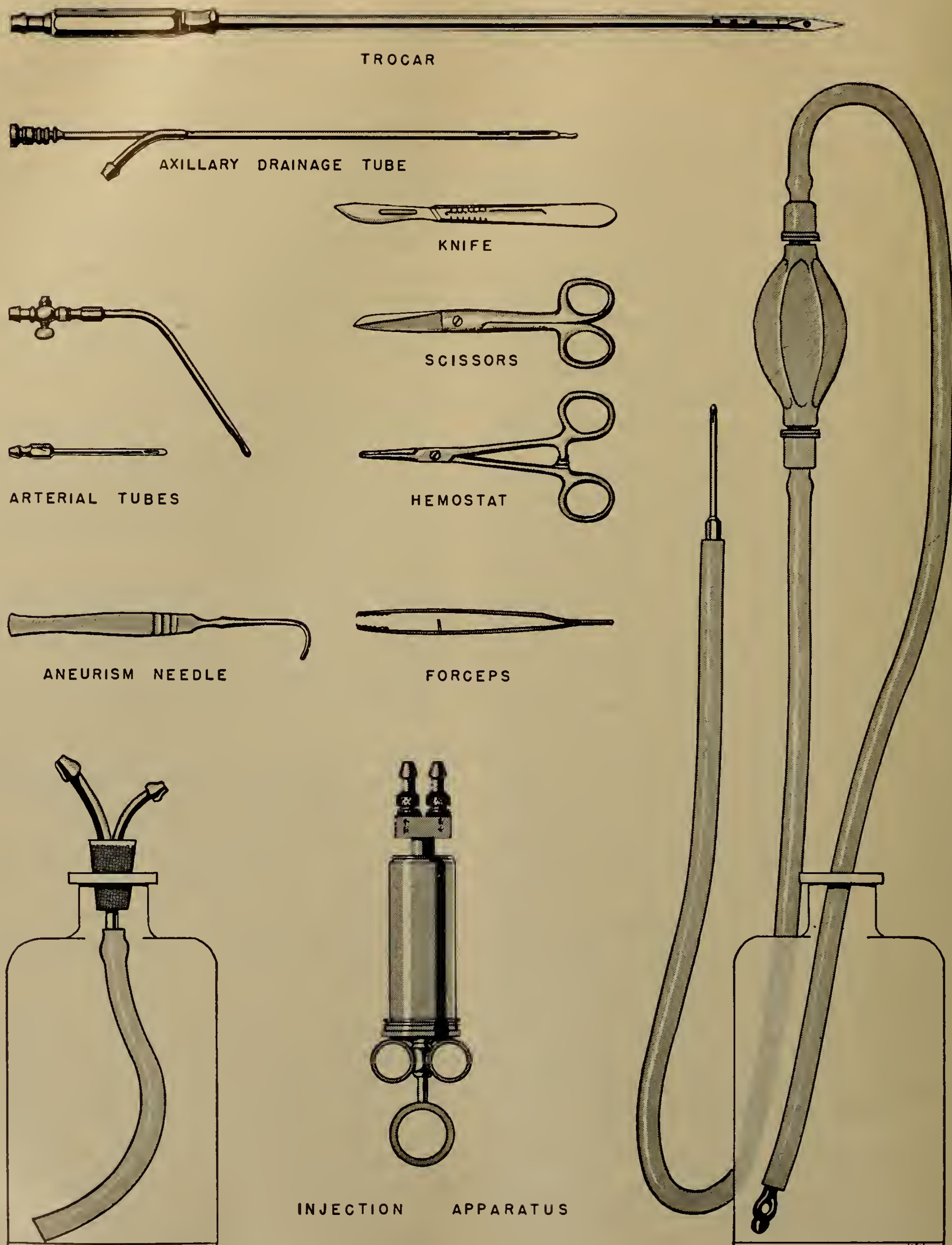

Figure 404.—Instruments in the Navy Standard Embalming Set.

uid contents from the viscera as possible, using trocar as described in text, and replacing removed contents with full strength embalming fluid. After the injection in paragraph 14, remove the fluid as much as possible from the viscera, replacing with full strength embalming fluid. This second removal and its replacement may not be absolutely necessary, but it does insure a more thorough saturation of these parts and less likelihood of putrefaction.

17. After embalming is complete, tie all vessels, close incisions.

18. Observe body closely for several hours, making particular note of "skin slips," soft spots and seepage from incisions. Hypodermic injections of fluid as described in text if necessary.

19. Sponge body with alcohol several times.

20. Seepage from incisions may be stopped by application of a small amount of flexible collodion.

21. Wipe face and hands, but do not wash.

22. Cover entire body with 2 percent phenol ointment.

23. Wrap body well with muslin, then impervious (wax) paper, and bandage securely.

24. Place in casket which has been well aired and sun-dried if possible.

25. Place pillow over feet and legs.

26. Pin lining of casket together across body.

27. Casket placed in shipping case. Clothing in good, clean condition, wrapped carefully, placed on top of casket inside shipping case.

28. Secure shipping case, make certain that all information that is required or necessary on the outside of the shipping case is legible.

The above outline is a check for preparation and encasement of remains, with unbroken circulation, for shipment from outside the continental limits of the United States.

When embalming a body with broken circulation, or where death has been by drowning, or other conditions prevail, special precautions must be observed. Study text thoroughly in these cases before proceeding.

If a communicable disease is involved, study not only the text for embalming and encasing procedures, but local laws which may be applicable, United States laws, and regulations promulgated by the United States Public Health Service.

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Chapter XII

THE MEDICAL AND DENTAL DEPARTMENTS WITH THE FLEET MARINE FORCE

Organization of the Medical and Dental Departments With the Fleet Marine Force

The hospital corpsman serving with the Marine Corps has an honorable heritage handed down to him from the battlefields, where Marines have won high honors. This heritage to be carried on requires the best service that you can give. The following organization outline will help you to see how casualties are handled by the corpsmen. However, you will have to serve with the Marines in the field before you will be fully qualified to carry out this important mission.

The Medical and Dental Departments are divided into two groups. (1) Organic sections of the combat elements, which provide medical and dental care or initial first aid. (2) The medical battalion, which supports and provides definitive surgical and medical care to those who cannot be further evacuated.

The division surgeon and the division dental officer with their assistants are in division headquarters. The force surgeon and dental officer are in force headquarters. These officers administer their respective services.

The medical and dental personnel attached to these units are a permanent part of the combat element; they train, live, and accompany the units to which they are assigned, at all times.

The infantry battalion section is composed of:

Two medical officers.

Forty hospital corpsmen.

They are divided into company aid men and battalion aid station personnel.

Company aid men are assigned to an infantry platoon, and accompany their platoon at all times and in all situations.

Battalion aid station consists of two medical officers and the remainder of the battalion medical section. They operate one or more aid stations in the immediate rear of the front.

The infantry regiment medical section is composed of:

One medical officer.

Fourteen hospital corpsmen.

This section establishes an aid station in the region of the regimental command post and, in addition, coordinates the evacuation of the three battalions of the regiment. The dental section includes one dental officer and two dental technicians.

Separate battalion medical sections vary in size depending on the size of the battalion with which they serve. These battalions are the engineer, tank, motor transport, service, signal, amphibian tractor, and headquarters and service battalions. In view of the fact that line personnel of these battalions are assigned to operate in the support of the infantry, the casualties that occur during an engagement are handled through the infantry battalion medical sections and the main effort of the separate battalion medical section is directed toward setting up an aid station in the area of their battalion command post, with medical personnel as needed being assigned to small detachments operating independently of the battalion.

Artillery regimental and battalion medical sections set up aid stations in the area of the regimental and battalion command post and in addition assign two hospital corpsmen to each firing battery.

Shore party regimental and battalion sections vary in size, depending on the particular mission, and have as their function the maintaining of the shore party evacuation stations on each landing beach. They facilitate the actual transfer of the casualties from the beach to the landing craft.

The Medical Battalion is comprised of six companies: a headquarters and service company,

three clearing and collecting companies, and two hospital companies.

The headquarters and service company is composed of administrative, record and supply personnel, dental personnel of the division dental section, and personnel of the Epidemic Disease Control Unit.

The three collecting and clearing companies are each composed of four medical officers, one MSC officer, seventy-eight hospital corpsmen, and twenty-four marines. The company is divided into two platoons, the collecting platoon and the clearing platoon.

The collecting platoon, which can divide into three sections of sixteen men each, has the function of evacuating casualties from the infantry battalion aid stations rearward to the clearing platoon.

The clearing platoon is capable of setting up a complete sixty-bed surgical hospital in the field and is highly mobile. Its function is to give resuscitation and definitive surgical care to casualties who are in immediate need and cannot withstand further evacuation. Normally, one clearing and collecting company is assigned in direct support of a marine regiment.

The two hospital companies are each composed of seven medical officers, one MSC officer, one dental officer, fifty-six hospital corpsmen, and twenty-six marines. Each hospital company is capable of setting up a complete two hundred bed hospital; and in addition to giving resuscitation and definitive surgical care, each can expand to provide hospitalization for a great number of minor wounded and sick. The marines assigned to the various medical companies comprise cooks, ambulance drivers, maintenance and security personnel.

CASUALTY EVACUATION

Casualties are removed from the combat area through the chain of evacuation. This chain starts with the company aid man, who is with the first marines of his outfit to hit the beach and the first member of the Medical Department to come in direct contact with front-line casualties. Other elements making up links in the chain, in order, are the battalion aid station, the collecting section, and the shore party evacuation station. The clearing platoons of the collecting and clearing companies are committed ashore in support of the regiment to which assigned as soon as the beach area becomes relatively free from fire, usually late on the second day of the assault. The two hospital companies become a link in the chain of evacuation after the attack has pushed inland from the beaches. A brief description of the employment and function of each link of the chain of evacuation follows:

Company Aid Man

He lands with his platoon and maintains a position in the immediate proximity of the front lines. When a casualty occurs, his first duty is to remove the casualty from the direct line of fire. It is here that training and cool appraisal of the situation are paramount. It is neither desirable nor necessary that the hospital corpsman expose himself recklessly in reaching the casualty. A knowledge of the field of fire, the type of fire encountered, and the appreciation of the protective features of the terrain add up to lessen the danger to the alert, trained aid man.

If time allows, consultation with the squad or platoon leader will result in a protection fire coverage that will give the venture a better chance of success. After removal of the casualty to a place of relative safety, such first-aid measures as are indicated and feasible are carried out.

These measures include control of hemorrhage, application of a battle dressing, morphine administration where indicated for pain, splinting of fractures, and the filling out of the emergency medical tag.

With the aid of litter bearers, assigned from marine service personnel, the casualty is removed to the battalion aid station. If the casualty is able to walk, he is directed to proceed to the aid station along the most protected route.

Battalion Aid Station

Personnel attached to the battalion aid station are divided into two echelons and land in the last two waves of the first trip of the landing craft carrying their battalion. They set up an aid station in whatever protected location can be found on the beach. As the battle progresses inland, the aid station deploys forward, maintaining a position as close to the front lines as is reasonably safe from direct rifle and machine-gun fire.

Casualties received here are given such further treatment as indicated to put the patient in condition to be further evacuated. Further control of hemorrhage, checking of dressings and splints, the administration of plasma or serum albumin to combat shock, and the administration of antibiotics are within the province of this section.

Collecting Platoon

One section of sixteen hospital corpsmen lands in direct support of each infantry battalion. The function of this section is to evacute casualties from the infantry battalion aid station to the beach. Initially, until the shore party evacuation section is landed, the section also facilitates the transfer of patients over the beach to landing craft for further evacuation to the off-lying ships. Evacuation to the beach is performed either by litter carry or by ambulances when they become available ashore. Collecting sections revert to their parent clearing and collecting company as soon as the situation ashore becomes somewhat stabilized.

Shore Party Evacuation Station

This section lands approximately the same time as the shore party commander and sets up a station for reception of casualties from the front. Casualties are given such supportive treatment as indicated and transported across the beach to landing craft for further evacuation to ships off shore.

Regimental Medical Section

This section lands on order with the regimental headquarters. It may or may not be a link in the chain of evacuation, depending on the road network. It functions in the same manner as a battalion aid station in the regimental headquarters area.

The clearing platoons land on order when the tactical situation permits. Their function is to give resuscitation by means of whole blood administration and complete definitive surgical care to those casualties who cannot withstand further evacuation. Usually one clearing and collecting company is assigned in direct support of one infantry regiment, but two or more may join together to form one large installation; or they may leapfrog one another along the chain of evacuation if the route becomes unduly lengthened.

The two hospital companies land on order and usually join together to form the division hospital, but they may also leapfrog along the chain of evacuation in prolonged penetrating operations.

SPECIAL ATTRIBUTES

Corpsman must have sound basic training in the duties of all hospital corpsmen. In addition he must possess further attributes that will not only enable him to give proper care to casualties but also provide him with a measure of self-protection as well. A majority of the time a medical officer will not be available at the spot where lifesaving first aid must be administered, and he is on his own. Even in situations where a medical officer is present to direct casualty care, the actual measures must be accomplished by hospital corpsmen when the casualty load is heavy.

Medical Attributes

The hospital corpsman must be an expert in first aid. He puts the patient in condition for evacuation over a sometimes long and arduous route. Particular attention must be paid to control of bleeding. It may be several hours before the casualty can reach further medical aid over rough terrain.

Splints must be applied not only to fractures but also to limbs that have suffered large debriding wounds in order to ease the patient during the litter carry and help prevent shock. Morphine must be administered with good judgment. The patient able to walk back along the line must not be "snowed under" with morphine lest he requires litter bearers. On the other hand, men in a semicomatose condition and suffering severe pain must be given enough morphine to quiet them to prevent their giving away the position of the troops to the enemy.

The hospital corpsman must have an accurate knowledge of traumatic shock. The ability to read the signs and symptoms of shock or impending shock and the decision as to what steps to take calls for keen judgment in caring for a casualty in the absence of a medical officer. Movement of a casualty in shock will increase that shock and sometimes result in the needless death of the casualty. It is better in such circumstances to delay evacuation and give supportive treatment such as rest, warmth, and the administration of

plasma. Gentle handling of these patients by the hospital corpsmen, litter bearers, and ambulance drivers is of the utmost importance.

The hospital corpsman must have a good knowledge of the intravenous administration of fluids. All hospital corpsmen in the field must be expert in the administration of intravenous fluids such as saline, dextrose and saline, plasma, serum albumin, and whole blood. The medical officer may be there to direct what should be given, but the hospital corpsman must be prepared to carry out these directives.

The hospital corpsman must know how to administer preoperative and postoperative care. The success of surgical procedure depends a great deal on his ability to properly prepare the patient for operation and to give supportive care following surgery. Routine hygienic care, the administration and supervision of continued flow of intravenous fluids, careful attention to the pulse, blood pressure and respirations of the patient and an appraisal of any change in his condition, changing of surgical dressings, and many more details of patient care and ward management must be well learned.

The hospital corpsman must possess an ability to improvise. This is one of his most important attributes in the field. While the general pattern of Medical Department activities and the methods of caring for casualties remain the same, every operation and every situation encountered in an operation has its problems that must be met and overcome. Terrain features, climatic conditions, and enemy interference combine to produce new situations that demand initiative and aggressive action.

Laboratory, X-ray, and operating room technicians will at times have to accommodate themselves to working spaces that at first view appear hopelessly inadequate; but with intelligent appraisal and improvisation they may be made to do.

The medical supply man may find that some of his vital supplies have been lost through enemy action and he must secure replacement from some other unit or from ships off shore.

The man directing litter bearers may find the route of evacuation impossible due to terrain features or enemy interdiction of the usual route and must utilize all his knowledge in selecting alternate channels. His whole attitude in the field must be that of accurately sizing up the conditions under which he must work and then strive to make them as near the optimum as possible.

The hospital corpsmen must possess an extensive knowledge of sanitation and preventive medicine. In the field he must have an intimate knowledge of all individual preventive medicine measures that must be carried out by the troops, not only to be able to instruct them thoroughly but also to insure that the troops are complying with such instruction. He must know the proper method of construction of such installations as galleys, seepage pits, garbage dumps, and heads; and he must be able to inspect them intelligently for proper maintenance. He must be familiar with the use of various compounds for preventive medicine employment such as DDT, insect repellent, and dimethylphthalate for impregnation of clothing. Water purification, under circumstances, must be a part of his learning. The hospital corpsman himself is not charged with actually carrying out such sanitary measures, but he must be able to supervise and see that personnel so detailed do carry them out.

Military Attributes

To successfully accomplish the purposes for which he is assigned, the hospital corpsman must be aware of those factors that enable him to adjust himself to life in the field and those which aid in preserving his well-being to the end that he may carry out his duties to the fullest extent. They include:

1. **Physical fitness.**—The field hospital corpsman must be in the best physical condition that it is possible for him to attain if he is to withstand the grueling days and nights of any prolonged engagement. Short rations, lack of sleep, and exposure to the elements in the presence of constant danger will break down the physically unfit individual quickly. Long hours in the shock ward and operating room likewise call for the highest physical stamina.

2. **Terrain appreciation.**—This implies the ability of the hospital corpsman to take advantage of whatever terrain features are available in order to provide the maximum protection for his patients and himself. This is especially necessary for the company aid man to help him in reaching and evacuating to a place of relative safety the

casualty on the front lines. It also is vitally important that all other medical personnel and installations take advantage of whatever protection the terrain offers, both from direct enemy fire and indirect fire such as artillery, mortars, and enemy air activity.

3. **Map reading.**—Every field hospital corpsman must be able to read accurately military maps. By use of these maps he can orient himself with the surrounding terrain and more intelligently plan the routes of evacuation. Travel between the various links in the evacuation chain and the search for isolated groups of casualties is greatly dependent on the individual's ability to read these maps. Requests for helicopter evacuation must be accompanied by accurate pin-pointing of the desired landing area.

4. **Use of small arms.**—Under many conditions the hospital corpsman is called upon to bear arms for the defense of his patients and himself. All men must be trained in the care and firing of the pistol and the carbine.

5. **Ability to live in the field under combat conditions.**—The hospital corpsman must be able to accommodate himself to his surroundings and make the best of the conditions under which he must function. He must learn to construct fox holes, erect shelter from the elements, employ camouflage, prepare his individual rations, and in many other ways acquire tricks of the trade. The willingness and courage with which he faces the rigors of field existence will determine, to a large degree, his ability to persevere.

A résumé of the duties of the hospital corpsman in combat with the landing force indicates the need for resourceful, well-trained, and courageous individuals. The corpsman who can successfully carry out these duties may regard his efficient participation with utmost pride and the sense of a job well done. Not only does the opportunity for saving life present itself more frequently in this branch of service but he has the knowledge of the tremendous morale factor that his presence inspires. The certainty of the fighting man that his aid man accompanies him into battle, shares his dangers, and is ever ready to give him quick and competent medical assistance, cannot be overrated as an aid to his willingness to carry on in the face of enemy fire. To the marine the hospital corpsman is "Doc," the family doctor; and to fulfill such a position to the utmost of his ability is a calling worthy of the best the hospital corpsman can give.

MEDICAL AID PRACTICE IN THE FIELD

Casualty Handling by Corpsmen With Forward Combat Elements

Casualty care in the field by the hospital corpsman goes far beyond the ordinary concepts of first aid in that far greater judgment must be exercised. Working independently as a company aid man or being required to take independent action when the battalion medical section is engaged in the care of a large number of casualties, the hospital corpsman is called upon to make decisions that vitally affect the eventual outcome of the seriously wounded. In effect, he must know the answer to three questions concerning the proper care and disposition of the individual casualty:

What must I do for the casualty at the moment right where he is?

Where should he be taken to secure the proper treatment for his wound?

How can I arrange to get him there in the best possible condition?

The following factors will influence his decision:

Nature of the Wound

Every casualty must be examined thoroughly to determine the exact nature of the wound, and also an appraisal must be made of the patient's general condition; this will enable the corpsman to judge whether or not the casualty needs immediate evacuation, and whether or not he can stand the evacuation procedure.

Penetrating wounds of the abdomen, chest, head and neck, as well as compound fractures or large debriding wounds of the extremities, must be given high priority in evacuation to surgical facilities. These cases demand individual attention and the corpsman acting independently must assure himself that they are started on the chain of evacuation before moving on to take care of lesser wounded men.

Litter bearers must be contacted and instructions given as to the need for gentleness of handling and the urgency in getting this type of patient to rear facilities. In cases with relatively

minor wounds which will not incapacitate them for duty, including minor illness and injuries, treatment will be given on the spot and as many of these men as possible will be returned to the lines. Such conditions as minor cuts, abrasions, superficial shrapnel fragments, sprains and strains, mild headaches, toothaches, diarrhea, constipation, and similar complaints can well be handled in a firm professional manner by the hospital corpsman.

The hospital corpsman has a great responsibility to the command in seeing that men with conditions of this nature do not become evacuated. Certain other types of casualties, slightly more severe than the above, can be given treatment and evacuation can be delayed until a lull in the fighting ensues. Thus the vital sorting of casualties initially falls to the first hospital corpsman that sees the casualties, and he must make the decision as to the need for evacuation, the urgency of evacuation, or the advisability of returning the patient to duty either temporarily or permanently.

Available Facilities

Once the decision is made and priority of evacuation is established with regard to the number of patients and the facilities available for evacuation, the decision as to where the patient is to be taken must be made. In the case of the company aid man, he will usually direct that evacuation be made to the next echelon in the chain, the battalion aid station. In rare circumstances such as independent action of his company on patrol activity or other isolated activity where evacuation is by special means such as helicopter, he may advise removal direct to the surgical facilities of a clearing company. In the event of possible evacuation to the rear of the battalion aid station, one must carefully consider whether or not the condition of the individual casualty requires immediate removal to the clearing company. It is important, therefore, that the hospital corpsman know at all times not only what is backing him up in the way of medical support, but exactly where each echelon is located at all times.

Evacuation Methods

There are four methods for getting the patient to the echelon best suited for the individual case—walking, litter carry, ambulance, and helicopter. Occasionally it will be necessary for individual carry for a short distance or improvisation of a litter by means of a poncho or blanket. The poleless nylon litter will sometimes be useful, particularly in getting a casualty out of rough terrain. Care must be taken not to make a litter case of an ambulatory casualty by injudicious use of morphine. In the event that the patient is in severe shock, it is frequently advisable to delay evacuation and treat the initial shock by warmth, rest, and morphine before attempting any prolonged evacuation. At the aid station level, plasma and serum albumin are available and should be used to put the patient in the best possible condition. Ambulance evacuation, being much faster than litter carry, should be used wherever possible. If there is a road network and the area is not under direct fire, an ambulance should be utilized as far forward as needed. **Helicopter evacuation is reserved for those cases which require immediate evacuation to surgical facilities.** Care should be taken that this means of evacuation is not abused in as much as helicopters are limited in number. Requesting one when it is not absolutely necessary may mean that one is not available at a time when it is more critically needed.

Requests for helicopters are made after a conference with the commanding officer of the unit. As stated before, helicopters may be necessary for evacuation from isolated units; in this case patients are evacuated because of their "inaccessibility" rather than because of the nature of their wounds.

The sorting of casualties is of paramount importance and calls for the exercising of excellent judgment on the part of the first corpsman coming in contact with the casualty.

MORPHINE AND OTHER NARCOTICS

The following observations are set down with a view to bringing the use of these agents better into line with the known facts.

Administration

Dosage.—Close to the maximum analgesic effect of morphine is produced by smaller doses than is generally supposed: Morphine, ⅙ grain (10 mg.). Larger doses chiefly cause undesirable side effects and impair the body's power to overcome adverse situations.

Do not administer morphine in greater single doses than 1/4 grain (15 mg.). Use small doses in patients to be transported by air, 1/8 grain (8 mg.) to 1/6 grain (10 mg.). Respiratory depression here is particularly undesirable. (Allay apprehension and fear of first flight with barbiturates, pentobarbital sodium, 1 1/2 grains (90 mg.) by mouth.)

Route.—Employ subcutaneous or intramuscular injection when a gradual, prolonged effect is sought. Avoid this route when the peripheral circulation is slowed by cold or low blood pressure (see discussion of delayed morphine poisoning in battlefield casulaties). A better choice in such cases is intravenous injection, which is also the best route when immediate pain relief is wanted, or when delayed absorption might prove harmful as in anticipated or developing shock. When injection is impossible (no syringe), morphine 1/4 grain (15 mg.) may be held under the patient's tongue until it is dissolved.

Indications.—The only important use for morphine is the relief of severe pain. Use aspirin or codeine for mild pain. In the absence of respiratory depression, head or chest wounds do not contraindicate small doses of morphine if the patient is in pain.

Do not use morphine routinely for all wounded men. Three-fourths of the severely wounded do not have enough wound pain to need morphine. But these men often suffer from anxiety and fear. These mental states are best treated with barbiturates, pentobarbital sodium, 1 1/2 grains (90 mg.) or sodium amytal, 2 grains (120 mg.) given intravenously, intramuscularly, or by mouth. Usually the suffering of the wounded man is due to a combination of wound pain and fear or apprehension. In such cases a small dose of morphine plus a small dose of a barbiturate will accomplish more than a large dose of either drug alone.

Men in shock rarely complain of wound pain; they do complain bitterly of thirst. In men whose hydration has been normal, thirst is caused by a low circulating blood volume. The use of morphine to allay the discomfort of thirst, acute though it be, is unwise.

Contraindications.—Seriously wounded men are abnormally sensitive to morphine and to all other depressant drugs.

Do not use morphine as a sedative in manic or hysterical states, for allaying fear or for promoting sleep (unless pain is present). Such use cannot be defended. For these conditions better agents are available (phenobarbital or pentobarbital sodium or paraldehyde).

Avoid morphine (except where pain is present) as a routine agent in the preanesthetic medication for general anesthesia of seriously wounded patients. Anesthesia is usually easy to induce in them in any case.

Do not administer morphine in the field to a patient who must walk back to the aid post. Do not give morphine at the aid post to the wounded man who must at once be evacuated to the rear as "walking wounded." He may become confused, lie down along the evacuation route, and go to sleep.

Morphine is contraindicated in shock unless pain is present. (See description below of effects morphine has on the respiration, circulation, and fluid balance.)

Morphine is widely recognized as dangerous in conditions of low metabolism such as hypothyroidism.

Morphine is largely destroyed in the liver; therefore, it should be used with great caution, if at all, in the presence of jaundice. It must be avoided in the presence of cirrhosis.

Use morphine with great caution, if at all, when even minor degrees of anoxia might be dangerous, as in head wounds, in circulatory impairment, or when respiration is already impaired, as by chest wounds, pneumothorax, hemothorax, pleural effusion, or pulmonary edema.

Morphine is not to be used to treat the restlessness arising from fear, apprehension, confused mental state, anoxia, anemia, low blood volume, low blood pressure, shock, hemorrhage at high altitudes.

Poisoning

Poisoning is first characterized chiefly by slow respiration and pin-point pupils. The outstandingly serious effect of overdosage with morphine is respiratory depression with anoxia, followed by circulatory damage. Less severe poisoning than the above, even poisoning from therapeutic doses, often complicates treatment: Morphine, in causing anorexia, nausea and vomiting, limits the in-

take of food and fluids by mouth and increases fluid loss in vomitus and sweat. (Its needless use in shock is to be condemned.) Severe constipation is produced.

Delayed Morphine Poisoning

When the peripheral circulation is sluggish or inactive, as it may be in patients who are chilled or who have low blood pressure, subcutaneous injections of drugs are poorly absorbed. Subcutaneous injection of morphine under such circumstances fails to relieve the pain of wounded men. Repeated injections, sometimes over a period of many hours, are not absorbed until finally the circulation is reestablished in the skin and subcutaneous regions by shock therapy and warmth. As shock is overcome, all the unabsorbed deposits of morphine are taken up by the active circulation so rapidly that signs of morphine poisoning previously not present then appear.

Although the intravenous use of morphine is desirable and would eliminate the problem, such use is not ordinarily practicable under outside field conditions. In the field, intramuscular injection followed by massage is the choice. Morphine should be injected low enough on an extremity so that a tourniquet can be placed proximal to spot if poisoning develops. Exercise care in recording the dose used, time given, and site of injection.

Treatment of Morphine Poisoning

Realization that morphine intoxication may have a rather abrupt onset many hours after the last morphine injection, under the circumstances discussed above, is a considerable help in recognizing the problem. Correct diagnosis leads to prompt and effective treatment. Place a tourniquet proximal to the site of the injection and briefly loosen it at intervals. Primarily, the treatment of morphine poisoning consists in effective prevention of anoxia.

Anoxia is best prevented by oxygen administration, with artificial respiration if necessary, which can easily be carried out with the aid of a closed anesthesia apparatus by means of intermittent bag pressure with carbon dioxide absorption. Ephedrine 3/8 grain (25 mg.) intravenously may be of value. It will help to support a falling blood pressure. Hypertonic glucose intravenously is a good diuretic and aids in excretion of morphine by the kidneys. Body heat should be conserved. If coma develops, insert a gastric tube in order to eliminate the possibility of aspiration of gastric contents. Moreover, frequent change of position is of value in avoiding the later appearance of pulmonary complications. The treatment is supportive while the morphine overdose is destroyed in the body, or excreted from it by natural means.

FIELD SANITATION

Failure to observe routine sanitary precautions so adversely affects the fighting capabilities of the troops in the field that a separate section will be devoted to the duties and responsibilities of the hospital corpsman as regards sanitation when he is functioning in the absence of a medical officer. Inasmuch as the hospital corpsman serving with small units is practically on independent duty, it is imperative that he have a sound working knowledge of routine measures that must be employed under a variety of circumstances to maintain the health of the troops of his unit at the highest peak.

The method of transmission, the diagnosis, and the specific preventive measures, such as inoculations for diseases of military importance, are covered elsewhere in this manual. Likewise, many of the technical details of sanitary procedure are covered in the section on preventive medicine (ch. VI). Reference will frequently be made to these chapters to avoid repetition.

Responsibility

The commanding officer of the unit has the over-all responsibility as regards sanitation, and the hospital corpsman will work with him or his authorized representative in accomplishing indicated sanitary measures.

The responsibilities of the medical department, as represented by the hospital corpsman while acting independently are as follows:

1. Instruction of all members of the command in routine sanitary measures, individual preventive medicine measures, personal hygiene, and special health hazards that may exist in a particular area.

2. Supervision of the construction of installations that have a bearing on sanitation, such as heads, galleys, garbage-disposal facilities, and improvised showers or wash racks.

3. Frequent inspection to insure that sanitary precautions, both group and individual, are being carried out.

4. Recommendations to the commanding officer as to the efficacy of sanitary measures, and reporting of repeated violations of sanitation. In this connection, if these reports are made in writing, much prompter action will usually ensue.

Routine Sanitary Measures

Water.—Purification of major supplies of water in the field is a responsibility of the engineers. Selection of water-procurement sites is cleared with the unit medical officer; however, rapid filtration, chlorination, and subsequent storage in large rubberized-fabric tanks are under the direction of the engineering personnel. Distribution is made to forward units in 5-gallon water cans or in 300-gallon water trailers. Individual canteens are filled from these cans or trailers. It may be safely assumed by the hospital corpsman that water so delivered is free from contamination.

Frequently, however, small units may be out of contact with established sources of purified water, and it becomes necessary for the hospital corpsman to supervise water procurement and decontamination. The following rules are for guidance:

All water must be considered contaminated unless secured from an authorized source.

Water from running streams is usually preferable. Likewise, water clear of sediment, taste, and odor is to be procured if possible.

Detailed instructions for purification of the contents of individual canteens, water cans, or Lyster bags are given in chapter VI, Preventive Medicine.

If no other method is available, water can be purified by boiling for 10 minutes.

Adequate and repeated instruction of the troops in the dangers of drinking water from unauthorized sources and constant alertness to prevent personnel from so doing, are two of the most important responsibilities of the hospital corpsman as regards water.

Enforcement of water discipline is a responsibility of the command. For planning purposes the desired daily minimum is 2 gallons for cooking and drinking for each individual. Absolute minimum for this purpose is 1 gallon per man per day.

Food.—For the initial phases of combat, food is furnished to the troops in individual canned rations called assault rations. No other food should be served until proper facilities are available for its preparation. These individual canned rations can be heated in hot water prior to opening to increase palatability and digestibility.

Cans, wrappers, and unused portions of these rations must be buried by the individual immediately on completion of the meal. Native foods, including fruits and vegetables, must not be utilized except in an emergency, and then only when authorized by a member of the medical department. When so used, fruits must be peeled and vegetables peeled and thoroughly cooked. As stated under water supply, constant instruction and alertness are necessary on the part of the hospital corpsman to insure compliance.

Field rations, other than assault rations, consist of canned dehydrated, or wrapped items which must be prepared under strict precautions. Rules to be observed in this preparation are as follows:

Galleys must be at least 100 yards from the nearest head. The area around the galley will be cleared of brush and grass and scrupulously policed for particles of food or other fly-breeding media.

Every effort must be made to protect food from contamination by flies during its preparation and serving. See fly control measures.

All personnel connected with food preparation and serving must maintain the highest degree of personal cleanliness possible under the circumstances.

Unless adequate refrigeration is available, the serving of left-overs is strictly forbidden.

There must be adequate hot water available for cleaning of pots and pans used in the preparation of foods and for cleaning mess gear before and after use. Immersion type heaters are available for heating water in GI cans; however, failure of these heaters to function will not be used as an excuse to avoid furnishing sufficient mess gear cleaning facilities. Water in GI cans can be adequately heated over a fire built in a trench. The following facilities are considered adequate for three hundred men: One GI can of boiling water placed at the head of the chow line in which all personnel will immerse their mess gear for a few seconds. Following chow, men will scrape refuse

into GI cans; the remaining food particles will be scrubbed off in hot soapy water in the first of three cans. A brush or swab will be available at this first can. The second can also contains hot soapy water, and the third can contains clear rinse water. Hospital corpsmen will keep a rigid watch to insure that water in all cans is boiling at all times while being used.

Galley waste and garbage will not be allowed to accumulate. Disposal will be made after each meal by trench burial, incineration, or by dumping into running water or at sea. Liquid galley waste and garbage will not be allowed to accumulate. It will be poured into a sump or drainage ditch. If the encampment is to be used for a period of over 1 week, grease traps will be constructed to forestall grease contaminating the drainage sumps or trench.

Natives will not be utilized for preparation or serving of food except under very stabilized conditions, and then they will be thoroughly examined by a medical officer for evidence of intestinal disease and other communicable conditions.

Disposal of Human Waste

It is absolutely necessary that troops in the field observe rigid rules regarding disposal of body waste. Feces which are not disposed of properly provide an excellent fly-breeding media and a source of many pathological organisms which can quickly be transferred to the rest of the command. The following rules for guidance cover the procedures under various conditions met with in the field.

Defecation during rapid movement of the troops will be in an individual hole, at least 1 foot deep, constructed with the entrenching tool. Earth will be replaced in the hole on completion. Disposal of urine presents no problem at this time.

During overnight bivouac and up to a period of 3 days stay in a given area, slit trenches will be constructed. These are simply straddle trenches that are 1 foot wide, 2 feet deep, and 3 feet long. They are constructed by personnel so assigned by the command. The removed earth is piled at one end of the trench and each person using the trench will cover his deposit with earth to prevent access by flies. When the trench has reached a level of 12 inches from the ground surface, it will be closed and, if possible, marked as a closed slit trench. Slit trenches should be constructed and maintained on the basis of one per infantry platoon or its equivalent.

During a planned stay in an area longer than 3 days, more stable heads will be constructed as follows:

General Features

Flyproofing.—Lids over holes should be so constructed that they will be self-closing. Pits must be lined with oil-soaked burlap extending 18 inches in the pit and about 2 feet laterally parallel to the surface of the ground to prevent the escape of fly larvae. Boxes should be fly-tight and as soon as the situation permits the entire structure should be screened.

Location.—If possible, the latrine areas should be down wind from the living area and so placed that they do not drain into the water supply. They should be placed within the area patrolled by sentries.

Burning out is not recommended in that it may produce a false sense of security and it is not effective in destroying larvae.

Use of larvicides.—Used motor oil or other viscous oil is moderately effective in suppressing both larvae and odor. It should be placed in the bottom of the pit and the pit sprayed daily. Sodium arsenite (2 percent in water) is the most effective larvicide but it must be handled with caution (refer to section on insect control).

Care.—Seats should be scrubbed daily with soap and water and the structure should be inspected for defects. Creosote in water used on floors and walls will preserve the wood and remove odor. A few shovelfuls of earth put into the pit every few days will also materially reduce the odor.

Disposal of urine is best accomplished by soakage pits close to latrines. If troops urinate before defecating, the problem of standing water in latrine pits is much simplified. Soakage pits 4 x 4 x 6 feet filled 4 feet deep with rocks and covered with earth are practically odorless and very satisfactory. Access of urine to the pit is by means of pipes or troughs stuck through the covering earth to the rocks below. (See fig. 374 ch. VI.)

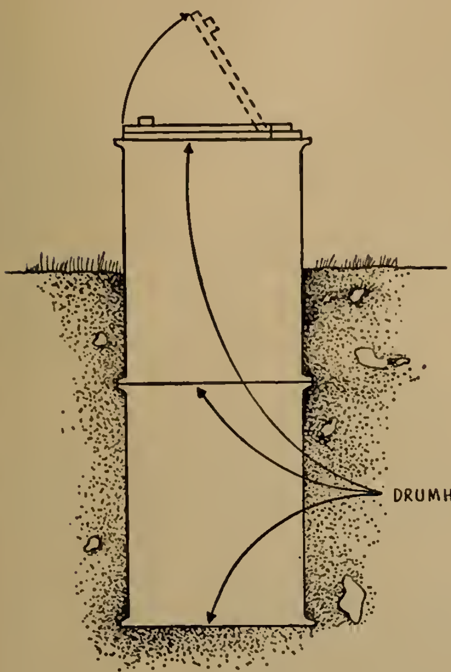

Figure 405.—Oil Drum Latrine.

Types of Latrines

Oil drum single latrine with portable seat.—This latrine consists of two oil drums. The lower drum has its top removed and the upper drum has both ends removed. The lower drum is sunk in the ground to a depth so that when the upper drum is placed on top of it, the top of the upper drum will extend above the ground level to a comfortable seating distance (12 to 18 inches). The seat once prefabricated can be used repeatedly at different sites.

The portable, plywood two or four hole latrine box.—This type of latrine is very satisfactory. It is fly tight as furnished. The pit construction is basically the same as given for the 8-hole latrine.

Eight hole type (most suited for units in semi-permanent location).—This type is constructed at the site and is usually of 1 inch lumber. Its design can be of any nature, but generally two rows of four holes each are best. The box should fit the pit fairly accurately so that no ledge is left to catch the feces. The depth of the pit is dependent upon the expected length of stay and the depth of the water table, but a depth 6 to 10 feet is optimum. (See fig. 373, ch. VI.)

Control of Insect Vectors

The greatest single precaution to be observed in preventing exposure of the troops to insects capable of transmitting disease is the avoidance of the native population and native villages, houses, and other installations whenever possible. To transmit disease, insects must have access to an infected individual or his bodily wastes and then travel to a healthy individual. Although some insects can cover distances up to 10 miles a day with the help of favoring winds, most of them have more restricted flight ranges and tend to remain where living conditions are favorable.

By keeping outside of the range of insect movement from an infected source, personnel reduce the chance of becoming infected. This in no way relieves the command and the individual from taking all possible precautions hereafter listed for protection against insects.

Methods of control of insect vectors are given in some detail in the chapter on preventive medicine. Methods that apply strictly to troops in the field will be enlarged upon and perhaps repeated for emphasis in this section. Supplies necessary for sanitation, including individual items such as louse powder, insect repellent, DDT and aerosol bombs, are procured by the unit supply officer. The hospital corpsman must check frequently to ascertain that an adequate supply of all items is on hand in accordance with current directives.

Flies present a difficult problem because they breed readily in almost any decomposing organic matter and because they are the strongest travelers of the common insect pests. The chief menace of "houseflies" is that they may wallow in potentially infected fecal material and then travel directly to mouth, mess kit, galley, or operating room. In order to exclude flies, one should promptly cover fecal material in slit trenches and heads with soil. When limited supplies of screening or insect nets are available, top priority for their allocation should be given to operating rooms, heads, and galleys. When food must be exposed in serving, it should be set out as little in advance

as possible; and when flies are abundant, an attendant should be delegated to chase them with a swatter or a switch with a few leaves on it.

Flies in enclosed areas may be killed with aerosol bombs. Prolonged residual effect is obtained by spraying buildings or even canvas surfaces with 5 percent DDT in kerosene. Emulsifiable DDT solution must not be used on canvas because the emulsifying agent causes canvas to leak.

Mosquitoes may transmit such diseases as malaria, dengue, and encephalitis (a form of sleeping sickness). Clothing and repellents are the most readily available protective agents against mosquitoes. Shirts should be kept on at night and the sleeves should be rolled down. Night swimming is to be avoided because of the large area of skin exposed to mosquito bites. Screens, tent liner nets, head nets, and nets over individual cots must be used whenever practicable. Aerosol bombs can be used to kill mosquitoes in enclosed areas. Residual spraying of walls or canvas with 5 percent DDT gives a killing effect on mosquitoes that may last for many months.

Whenever a choice exists, troops will bivouac on high ground well away from swamps, standing water, or native villages.

The hospital corpsman must be alert to the availability of DDT fogging equipment. This equipment is usually carried by higher echelons and is under the cognizance of the epidemic disease control personnel. Whenever possible, during temporary bivouacs, he should request fogging of the bivouac area, including such potential fly and mosquito breeding areas as swamps, standing water, or native villages.

On reaching a bivouac area for temporary or semi-permanent camp, the hospital corpsman, after making a brief survey, should request from the commanding officer a sufficient working detail to accomplish local mosquito and fly control as outlined in the chapter on preventive medicine. Clearing of brush and grass and filling or draining small areas of standing surface water in the immediate area are indicated if heavily infested.

Lice live in clothing on the body. They are readily killed by 10 percent DDT powder dusted into the clothing and particularly rubbed into the seams. Some strains of lice are resistant to DDT. They may be destroyed by other insect powders, by laundering, or by steaming the clothing. When such measures are not available, lice may be removed by washing the clothing in scalding hot water. Lice are likely to be prevalent when it is impossible to keep the body and clothing clean. They are contracted from other infested individuals with whom one comes in close personal contact as in crowded jeeps, crowded trucks, or foxholes. Since natives are usually infested with lice, it is unwise to enter their houses or to pick them up in jeeps and trucks.

Where louse borne epidemics are a possibility among the native population, the epidemic disease control personnel should be requested to dust the natives with DDT powder, using power or hand dusters.

Ticks are encountered in grass, underbrush, and wooded areas. Clothing and repellents, used as described later under mites, afford some protection. Personnel operating in such areas must be instructed to make frequent inspections of their persons for the presence of ticks. Care should be taken in removing ticks, as the body fluid of the tick expressed by crushing may be infective. A lighted cigarette tip held closely over the tick will cause him to release his grasp and he may be easily released.

Fleas are dangerous to man when they have recently bitten rats infected with plague or the rat form of typhus fever. They are most prevalent in areas, particularly buildings, occupied by rats. Native buildings should be avoided if possible, and fleas may be eradicated by residual spraying with 5 percent DDT in kerosene.

Mites are almost minute relatives of the ticks. The itch mite causes scabies, known as seven-year itch. It is contracted by exposure to infested clothing or blankets. Treatment is by one of several ointments containing sulfur or eurax. Chiggers are a form of mite and their bites are best treated under field conditions by application of collodion. Other mites are capable of transmitting scrub typhus. These mites are mostly found in high grass called kola grass. Individual protection against mites is by insect repellent. This must be carefully applied to the skin and clothing

around the ankles, wrists, neck, and waistline. Group protection in bivouac is by eradication of grass and brush by clearing or burning.

Rats and other rodents in the field are attacked by poison. The most effective means is by use of red squill.

Rodent control is described in the chapter on preventive medicine. If rats constitute a menace, it is best to request trained personnel from higher echelons to deal with the problem.

PERSONAL HYGIENE

Hospital corpsmen serving with forces in the field must be thoroughly familiar with the practical details of personal hygiene, not only to properly care for themselves but also to enable them to instruct troops for whom they are responsible. As in many other medical matters, while serving with a small unit or in the absence of the medical officer, the hospital corpsman is the authority on the subject and must be prepared to give competent and reasonable advice to his commanding officer.

Personal hygiene comprises the measures that the individual can and should carry out to protect himself from disease. The hospital corpsman should constantly strive to attain the optimum by his instruction and advice; and although perfection cannot always be reached, the below listed practical points should be feasible and observed under most conditions.

Bathing.—Complete bathing is practical under combat conditions only when the outfit is in a rest area or not engaged. Hospital corpsmen should be alert to the opportunities for bathing at these intervals, either in authorized bathing areas (streams or lakes) or at portable showers. Anticipation of the troops' needs in this regard sometimes means the difference in whether or not the troops will have the opportunity. Bathing out of helmet, covering at least the armpits, groin, and feet, can be accomplished under almost all but the most difficult circumstances and should be encouraged. These areas must be wiped thoroughly dry after bathing.

Care of the feet.—Much foot difficulty can be prevented by an active interest on the part of the hospital corpsman during the precombat phases of an operation. Frequent inspections of the feet in conjunction with the commanding officer should be carried out. Proper fitting of shoes must be assured. Chronic infections, blisters, calluses, and ingrowing toenails should receive proper attention during this time. A few individuals will be found to have skeletal defects of the feet that must be referred to a medical officer with a view to eliminating the individual from duty with the foot troops.

Under march and battle conditions, the hospital corpsman should make every effort to have the men bathe their feet, thoroughly dry them particularly between the toes, apply foot powder, and change into dry, clean socks once daily.

Diligent use of foot powder will usually prevent fungus infection or clear up incipient cases. Blisters may be treated with puncture under aseptic conditions and tape dressing. If the blister has opened, removal of dead skin and painting with tincture of benzoin are recommended.

Frequent inspections during lulls in combat will often result in apprehending foot conditions when they are most responsive to treatment, and they will also serve to make the troops conscious of the proper care of the feet.

Care of the feet under particular conditions giving rise to frostbite and trench foot are discussed in a previous chapter.

Venereal diseases.—Details regarding venereal disease and usual prophylactic measures are outlined in the chapter on "Preventive Medicine." The hospital corpsman must not be lulled into a false sense of security regarding the exposure to venereal disease of troops even during combat operations. The women available to troops in the field, while less in numbers, have a much higher incidence of venereal disease than the peacetime population. Instruction as to the dangers of exposure and the need for prophylaxis must be constantly given. In some circumstances, particularly when the troops are in a temporary rest area in the vicinity of native villages, routine injection of 300,000 units of penicillin weekly in all known promiscuous women or prostitutes can be carried out in conjunction with the local authorities.

SUMMARY

In carrying out any sanitary or preventive measures, the hospital corpsman must anticipate the needs of the troops. Proper indoctrination of troops, securing of adequate supplies, and acquiring information regarding possible health hazards must be accomplished during the precombat phase. The hospital corpsman must be aware that compulsory observance among both the command and the troops of routine sanitary precautions and individual preventive measures is a very discouraging task. This knowledge, however, must not deter him but only serve to redouble his efforts. Earnest warnings, which are presented to the unit commander, relative to the dire results of the failure of disease prevention will be the hospital corpsman's most effective weapon in securing cooperation from all hands.

Chapter XIII

MEDICAL ASPECTS OF ATOMIC WARFARE

All medical personnel should have a general knowledge of atomic warfare and its problems; i. e., the strategic and tactical applications, the limitations of defensive measures, and radiological safety operations. They should have some understanding, too, of the devices employed in detecting and measuring radiological hazards, the principles of avoidance, and personnel and matériel decontamination.

HISTORY OF THE ATOMIC BOMB

Development of the atomic bomb probably dates from 1939 when Professor Einstein wrote to President Roosevelt suggesting that intensive research work be carried on to investigate the possibilities of using the fission of uranium in a branching chain reaction as a source of energy for military application. It was known that uranium was fissionable by neutrons with the liberation of tremendous quantities of energy and that, if this energy could be liberated in a very short time, a powerful explosion of great military value could be produced. The culmination of the concentrated effort of thousands of scientists, engineers, and workers, and the expenditure of billions of dollars occurred on 16 July 1945, when the first man-made atomic explosion took place.

THE ATOM, ATOMIC ENERGY, AND FISSION

These terms are easy to understand once a little thought is given to their simplicity.

If a lump of salt is crumbled into grains it is still salt. If these grains are still further picked apart under a microscope they will still be salt grains. But eventually there must be a smallest unit of salt beyond which we cannot go. In the same manner there must be characteristic units of every known substance, pepper, iron, glass, lead, wood, and all substances.

This was one of the pictures of matter as handed down by the early Greeks. A substance is made of tiny pieces, each of them indivisible, each alike, and each characteristic of that substance. The Greeks called these pieces atoms, but thought of elemental atoms in terms of earth, air, fire, and water.

The modern concept of the atoms differs vastly, in that there are more than 90 types which form the single units of structure in nature, just as stones form the single piece of structure in a stone wall.

The Greeks thought of cutting up a piece of salt. It has since been learned that it can be taken apart chemically, reduced to two elementary substances, sodium and chlorine. We distinguish between compound substances which can be taken apart chemically. Substances which cannot be further taken apart, are called elementary substances. The name atom has been given for the smallest unit of one of these elementary substances.

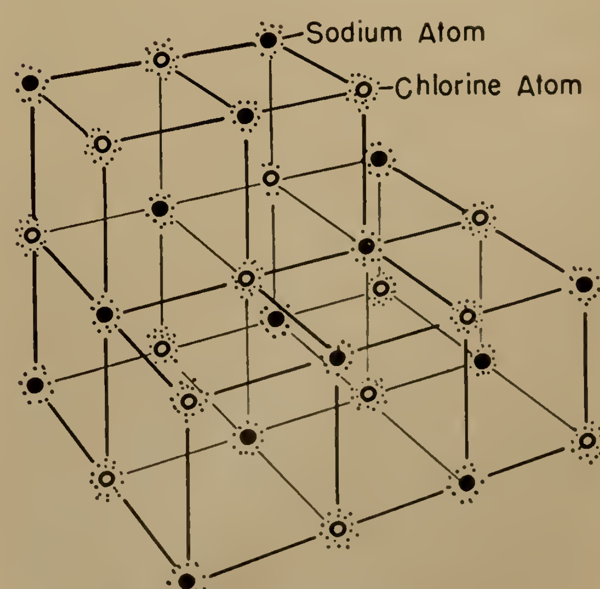

Figure 406.—A Molecule of Sodium Chloride.

The two elementary substances of which salt is composed, each have their own atoms. They build up a strong framework in which each kind of atom locks the other into place.

Every substance is built up of atoms, either all of one kind, or of several kinds linked together. In a solid the atoms are arranged tightly and compactly. When this solid is melted and becomes liquid, the atoms wander from their fixed stations but are not lost. When the liquid boils the atoms dart about and take up more and more space, but are still there. This can be shown by taking a piece of ice, a solid, heating until it melts which is a liquid, then boiling and watching the steam arise. If this steam is condensed it will form back into a liquid on cooling, and with sufficient freezing will again form into the solid.

The atoms of one elementary substance are different from those of other elementary substances. There are as many kinds of atoms as there are elementary substances, totaling 98 in all.

It has been discovered slowly in the past 50 to 75 years that nature has built itself soil, rock, air, water, ores, living bodies, and all objects from these 98 atoms. It has been found further that these atoms each have their own and often complicated structure.

All atoms are assembled from three kinds of fundamental electricity. They are the proton, which is electrically positive; the electron, which is electrically negative; and the neutron, which is electrically neutral. The proton and neutron are heavy particles each having about 2,000 times the mass (weight) of the electron.

Atoms vary only in the number of fundamental particles from which they are assembled. Each kind has essentially the same structure. At the center is the heavy nucleus, the heavy protons and neutrons are concentrated in this center. On the outskirts of the atom are the electrons. These are in constant motion and circle about the nucleus of the atom similar to the way in which the earth circles the sun, except that there are more of them and their orbits are not so fixed.

The heavy nucleus made of protons and neutrons tightly bound together, acts as an anchor and helps keep the electrons from wandering too far.

Each elementary substance has a fixed number of protons in its atoms. Hydrogen, the lightest element, has one proton for its nucleus and one electron circling around it. Helium has two protons and two neutrons in its nucleus with two electrons circling it to balance the electrical charges.

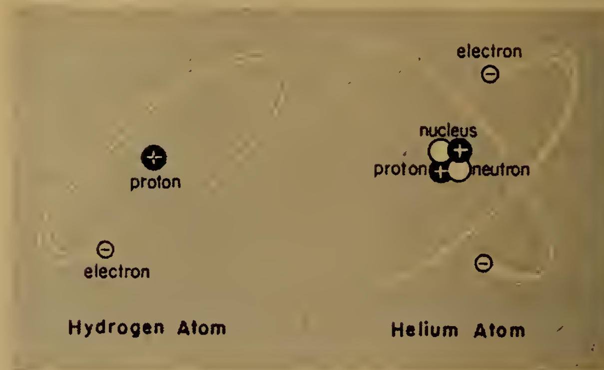

Figure 407.—An Atom of Hydrogen and Helium. Note the elliptical path of the electrons about the nucleus.

Uranium has 92 protons and 143 neutrons in its nucleus, with an average of 92 electrons circling it.

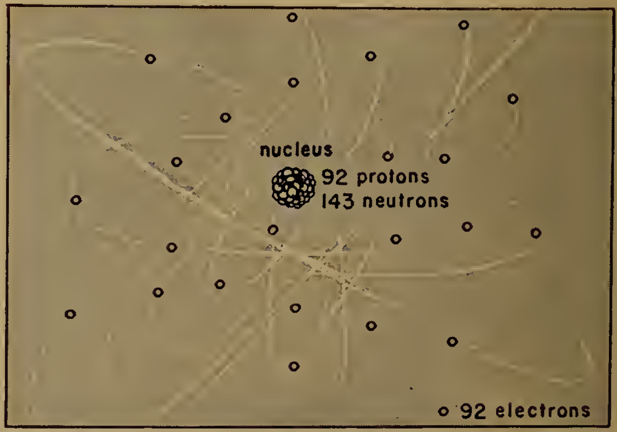

Figure 408.—An Atom of Uranium. Note the electrons at varying distances from the nucleus.

The protons which are electrically positive, should repel each other with force. Somehow an unknown force, which is not understood at present, holds the protons and neutrons together as the nucleus of the atom. This force which holds the protons and neutrons together, is called atomic or nuclear energy.

From time to time some of the heavy atoms release a part of this nucleus of their own volition. These are the radioactive atoms such as radium.

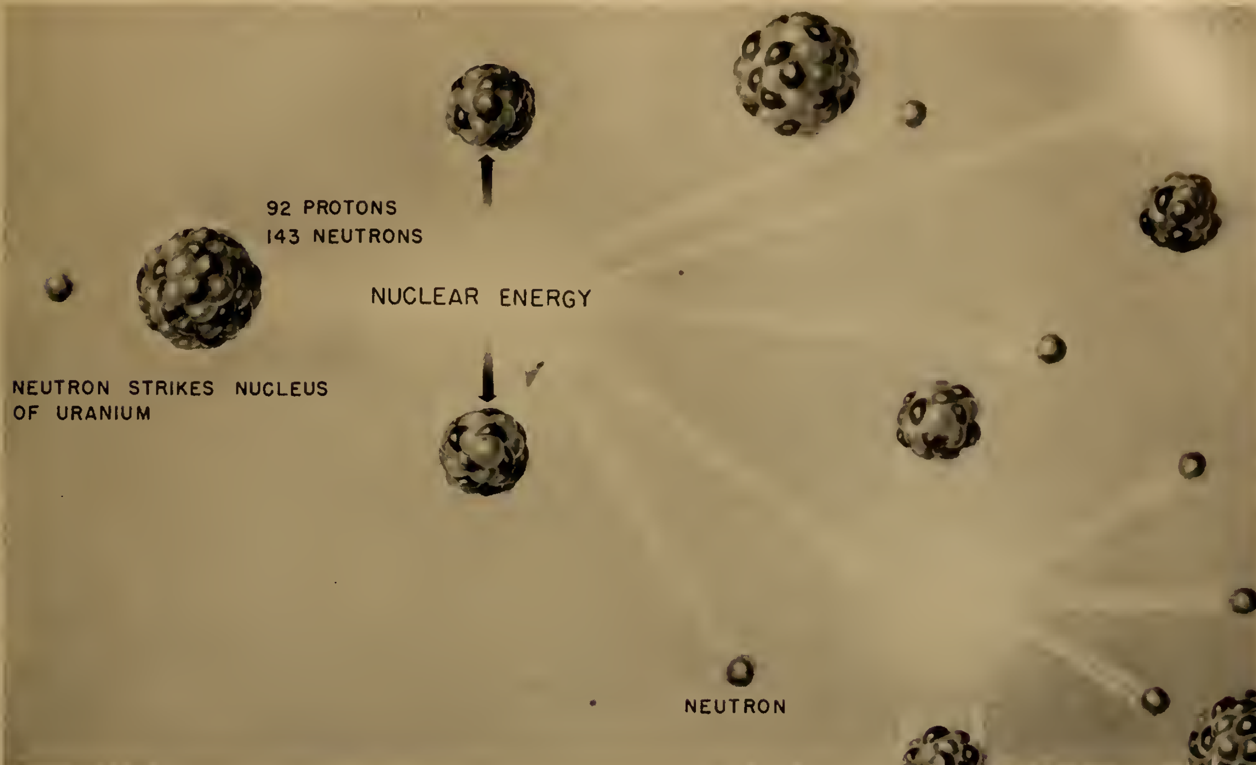

Figure 409.—Fission. (Chain Reaction). Note that many of the neutrons do not strike a nucleus.

The nucleus can be made unstable by being struck with an extra proton or neutron. If the proton is used it has to be released with great energy because the positive nucleus repels it. The neutron is more ideal to split the atom as it is neutral and the positive proton of the nucleus does not repel its approach as strongly as that of another proton.

When a neutron strikes the heavy nucleus, it usually makes it unstable. The nucleus then breaks into a more stable form. Some of the binding or atomic energy is released during this process. If the parts of the rearranged nucleus are weighed, they will be found lighter than they were before. But this loss in weight exactly balances the energy which has been released.

This breaking apart of an atom is called fission. To make this fission worth while, a reaction is required which will release neutrons of itself as it goes along. Such a reaction was discovered in the breakup of uranium.

When the nucleus of uranium is struck by a neutron, the nucleus breaks up in such a way that, in addition to two equal halves, it also releases several of its own neutrons which go through the rest of the material, each released neutron striking another nucleus, and another burst of energy is released, more neutrons are released and the reaction is carried on in a continuous chain until the material available is exhausted.

The atoms which do this most violently are uranium and plutonium. These were the substances which were used in the atomic bombs which were used in World War II.

When this reaction is carried out, a great amount of energy is released in the form of heat and radiation.

Simply then, the atomic bomb is a container filled with a radioactive elementary substance, uranium or plutonium. A trigger is placed in the bomb, and at a prearranged time the trigger sets off neutrons which set off the chain reaction described above.

It has been found and proven by experimentation that various types of emissions are emitted by radioactive elements. These consist of three types, alpha particles, beta particles, and gamma rays.

Alpha particles have greater energy but are so large they cannot penetrate a few sheets of paper. Beta particles are electrons and ordinarily cannot penetrate a sheet of aluminum more than a few millimeters in thickness. Gamma rays can penetrate slightly a sheet of lead 5 centimeters or more in thickness depending on their energy.

Gamma rays are similar to, and act as do X-rays of high frequency. They move at the speed of light and with wave motion. They differ from light only in having a much higher frequency; their wave length being shorter. The wave length is the main distinction between different types of electromagnetic radiations. The following are listed in sequence in order of increasing frequency and penetrating power: Radio waves, radar, radiant heat, infrared, visible light, ultraviolet, X-rays, gamma rays, and cosmic rays. To stop gamma ray radiations from radium, several inches of lead are required, while it is necessary to use several feet of lead or concrete to stop gamma rays from an atomic bomb explosion.

EXPLOSIONS

An understanding of some of the basic principles concerning explosions in general is necessary in order to have a clear idea of the effects on the human body by the forces set in motion by an atomic explosion. **An explosion is defined as the sudden generation and liberation of energy, occurring before the constituents which cause the reaction and the reaction products have had time to separate appreciably.**

The most important factor in determining whether or not an explosion occurs in a reacting mass is **the speed of the reaction.** If the energy of the reaction can be transferred to the surroundings as rapidly as it is evolved, there is no explosion. On the other hand, an explosion is said to occur when the reaction products and energy cannot be dissipated as quickly as they are formed. **There is no difference in the basic processes involved, only in the reaction rates.**—Thus a boiler producing steam does not normally cause an explosion, since the energy of the expanding steam is transferred to the machines which the steam operates. However, an explosion results when the steam cannot expand but is confined in the boiler. The pressure builds up until the walls of the boiler rupture. The sudden expansion of gas (energy liberation) cannot be immediately absorbed by the boiler's surroundings, and an explosion occurs.

The same concepts hold for chemical reactions.—Thus the burning of coal in air proceeds at a slow enough rate for the heat of the reaction to be dissipated. However, if the coal is finely ground, heated and thrown into a container of oxygen, the reaction proceeds so quickly that an explosion occurs.

It has been determined that the energy liberated per pound of exploding TNT is approximately 5,000 British thermal units. It has been stated that the energy liberated by an atomic bomb is equivalent to that of 20,000 tons of TNT. Thus the energy liberated by 20,000 tons of TNT may be calculated. This value is about the same as that theoretically obtainable by fission of only 5 pounds of U_{235}. However, it is well known that the amount of material in the bomb is considerably greater than 5 pounds, probably several hundred pounds. Therefore, it can be deduced that the bomb's efficiency is rather low, probably only a few percent.

EFFECTS OF AN ATOMIC BOMB EXPLOSION

The wide extent of the damage resulting from an atomic explosion will be more clearly understood after considering the source of the explosion's energy. In the words of a prominent scientist, "When the bomb is detonated in the middle of a city it is as though a small piece of the sun had been instantly created. There is formed what we have called a ball of fire, which is a hot glowing mass something about a third of a mile across, with a temperature in its center which may be as high as 100 million degrees Fahrenheit."

The effects of the formation of this small piece of sun are as one would expect—a terrific shock wave of displaced air—winds having a velocity of 500 to 1,000 miles per hour. Simultaneously with the explosion great quantities of radiation are emitted.

At Hiroshima the blast effect destroyed one-story buildings in an area of a mile and a half radius from the point of explosion. Brick multistory buildings were destroyed rather generally up to 5,700 feet from the center and reinforced con-

crete buildings up to 2,000 feet away had one-third their area rendered useless.

These figures give the damage caused by blast alone and do not include the damage caused by the fires of secondary origin. Widespread fires resulted from broken gas mains, overturned stoves, etc. A large percentage of persons who survived the blast and fires later succumbed to the internal burns caused by the radiumlike emissions from the bomb.

The fission products of U_{235} are mainly radioactive, liberating alpha and beta particles, and gamma rays, as well as neutrons. The radiations affect the blood-forming tissue in the bone marrow, and the whole function of the blood is impaired. The blood ceases to coagulate, oozes in many spots through unbroken skin, and seeps internally into the cavities of the body. The white blood cells, fighters against infection, do not reproduce normally. Thus, infection prospers and the victim dies, usually within 2 or 3 weeks after exposure.

In the event of an air explosion, the radioactive cloud rises quickly to a height of 60,000 or 70,000 feet and is diluted and disseminated over a very considerable area so that the residual effects in and about the area of the explosion are of relatively little importance. In the under water type of explosion the radioactive cloud is almost entirely confined within the rising column of water and is, shortly thereafter, deposited in the immediate vicinity of the blast together with the radioactivity which has been induced in the water and the marine life. It can readily be seen that the latter condition imposes a hazard of almost unbelievable proportions from radioactivity alone and to this must be added the fact that the unfissioned material of the bomb as well as many of the fission products have extremely toxic properties.

RADIOLOGIC HAZARDS—TWO MAIN TYPES

Radiologic hazards of atomic explosion and the peculiar patterns these hazards present are divided into two main types and these two differ markedly in their basic characteristics, each requiring an entirely different approach. This may be confusing unless clearly differentiated in the mind of the individual.

External radiation.—The first type of hazard is that of external body radiation. This is in all respects similar to that which would be encountered if the individual were exposed to a giant X-ray machine except that the rays would, in the first instance, be coming from all directions instead of from a single source. This form of hazard is well known in medicine and certain of the industries. Never before has this type of radiation been encountered when it consisted of such a variety of forms, with such a wide range of energies, nor when covering such a wide range of effectiveness. It is impractical for one to think of this form of external radiation as directly comparable to the hazards of an X-ray machine although the concepts of protection which have been developed and applied to X-ray are applicable to certain aspects of the hazards of atomic explosion. The essential difference is that the X-rays come from a point source, whereas the ionizing radiation resulting from atomic explosion comes from an "extended" source.

To describe this difference in the pattern of the hazard, the radiologist speaks of this as the "geometry" of the radiation and it is of great importance in the understanding of the characteristics of radiation dangers. The maximum exposure limit of 0.3 roentgen per week is based upon "total body radiation" and applies principally to regular workers in radiation. If exposure was from a point source and the area of exposure greatly reduced, as to a few square centimeters, several thousand roentgens may be administered without danger of general injury to the patient. This is not infrequently done in the case of small lesions in children. This is an unusual instance, however, and does not permit us to relax in respect for the tolerance limits which have been established for purposes of safety.

Since most fatal cases become so by a complicating bronchopneumonia, the use of prophylactic injections of penicillin (300,000 units daily) is indicated.

When an individual receives a **total body radiation** of 400 roentgens in a short period of time, it is certain that the individual will become seriously ill and may die. Three hundred roentgens may prove fatal in some cases. Between 100 and 300, serious injury is almost certain to occur. Be-

tween 25 and 100, there will be some injury, probably not enough to incapacitate or endanger the future health of the individual.

On the other hand, we do not know accurately at the present time what effect these smaller doses may have on gonadal tissue or what far-reaching genetic changes may be produced. Below 25 roentgens, it is unlikely that any injury of importance will occur although many well-informed radiologists feel that doses as small as 10 roentgens may have some subtle injurious effect.

Certain factors have an important bearing on the nature and extent of the injury sustained. They are primarily characteristics of the radiation rather than of the individual and include:

1. **The size of dose delivered** which is usually expressed in total roentgens (r) of exposure. Roughly, the greater the amount of irradiation, the greater the absorption by the tissue and the greater the resultant injury.
2. **The hardness of the ray** has a bearing on the ability of the ray to penetrate. In general, the shorter the wave length of the ray the more penetrating it is and the greater is the possibility of absorption and resultant injury.
3. The **"duration of exposure"** is of great importance although it is now thought that a large dose given, or received, in a very short time may not be as fully absorbed as a smaller amount received over a longer period of time. It is, however, decidedly more dangerous.
4. **The size of the area irradiated.**—The larger the area exposed to irradiation, the greater the absorption.
5. In general, **gamma rays** and neutrons are more penetrating and damaging than beta particles. Neutrons are especially harmful.
6. **The greater the energy** of the radiating medium, the greater the resultant damage.

There is a great deal of evidence to show that the "total amount of radiation received" is the factor which decides the severity of remote damage. The period of time over which this dosage was absorbed is of lesser importance. However, as regards acute effects, time is very important. A few hundred r. given in a matter of minutes will produce serious radiation illness; spread over weeks the same dosage will be fairly well tolerated.

Internal radiation.—This is a type of hazard which is encountered in the radium industry; particularly in the radium dial painter's laboratory. It is an internal poison, comparable in many ways to any chemical type of internal poison, particularly by the heavy metals. It has been long known that radium, ingested or inhaled, even in dilute form tends to enter the blood stream and deposit in the bones. In some of the bones very little harm may result but when it settles in the blood forming marrow, the characteristic picture of radium poisoning results. An exactly similar picture may result from the ingestion or inhalation of particulates of the fissionable material or the fission products of the atomic bomb.

The alpha particles which are emitted by these materials are extremely high energy particles. Although they have a very limited range and low powers of penetration, they are capable of producing some of the most insidious and destructive of the radiation injuries. From a standpoint of external radiation, the alpha particles have an almost negligible effect. It is only when the alpha emitting materials are absorbed by the body that destructive effect becomes important. This has added significance when it is remembered that alpha particles are very difficult to detect and their presence easily overlooked or disregarded by the uninformed. There is no instrument suitable for field use which will detect alpha particles. It may be pointed out here that under field conditions, it is necessary to calculate the amount of alpha hazard present from the measurements of beta and gamma radiations. The material which is likely to be the most resistant over a period of years consists of the long life fission products which are alpha emitters. One can readily understand the need for particular care. Protection against this hazard is accomplished by avoidance only.

Inhalation can be avoided by the employment of suitable oxygen rescue breathing apparatus or gas masks with appropriate filters.

Access through the skin can be prevented by wearing clothing which prevents contact of the particulates with the skin, by measures of hygiene, and the care of possibly contaminated wounds.

One of the most important principles is the development of a proper understanding of what the hazard is, its peculiarities and characteristics. Only on such a foundation can an approach be made to the solution of the safety problems which this form of hazard presents.

THE GEOMETRY OF RADIATION

At the time of atomic explosion, there is emitted an intense radiation which includes beta particles and gamma rays and neutrons together with radiant heat and light. Effective ranges of these factors differ, but in each, the intensity decreases with the distance from the source. The range to which neutrons are emitted is less than the range of gamma rays. The infrared and ultraviolet rays, in intensities sufficient to injure skin at least temporarily, extend to a distance considerably beyond that of the gamma rays. At the time of explosion, a "ball of fire" is formed, which continues to emit radiations for a matter of several seconds during which time it is rising from the original point of detonation. In a relatively short time, it reaches a height from which none of the radiations reach the earth. Therefore, there is a moving source of radiation which, as it goes skyward, subjects the individual on the ground to continuous exposure during the time that it is in range of the individual. The total effect will be, then, a combination of the initial "instantaneous" radiation of extremely short duration, and the "delayed" radiation which lasts for several seconds.

Theoretically, if an individual is exposed in the open, only the side of the individual exposed to the direct rays would be affected. Flash burns and eventual loss of hair in those individuals who survive would be unilateral. Practically, this purity of exposure is almost impossible since there would always be some reflection of rays from the ground and from nearby objects. This reflecting effect is known as "scattering" and is most characteristically seen inside a building.

The gamma rays entering the building would be scattered in such a way that the total body radiation would be considerable and important as a killing agent. It would be possible for an individual so exposed to accumulate a lethal exposure as a result of over-all radiation without having sufficient local exposure to produce loss of hair. An individual in this position would be almost completely protected from infrared and ultraviolet rays.

INDUCED RADIOACTIVITY

As a result of neutron bombardment, certain elements become artificially radioactive and, following the atomic explosion, constitute what is termed "induced activity." In sea water there are several elements including sodium, chlorine, and iodine, which may become radioactive in this manner. Of these, by far the most important is **sodium.** It emits both beta particles and gamma rays. It has a relatively short life so that in a few days there is little hazard from an external radiation standpoint. Certain metals, particularly those containing copper, bronze, or manganese may be made radioactive. Also certain soils, drugs, (notably Salvarsan), table salt, and even on occasion the gold fillings of teeth may become artificially radioactive and constitute a hazard.

The induction of radioactivity in the soil is of particular interest and importance because it is possible, by the use of instruments presently in use, to detect and measure this activity from the air at a height of over a thousand feet and thus chart a geometrical outline of the areas of contamination together with the intensity of contamination. This is of particular importance over land areas but is also important in marine survey where activity has been induced in the sea water and in both marine plant and animal life.

FALL-OUT

More important than the induced radioactivity is the contamination which occurs due to the "fall-out" of radioactive materials from the atomic cloud. This is serious in the case of an underwater blast. The pattern of fall-out will vary considerably with wind and weather conditions as well as with the location of the detonation. Humidity, rain and wind will affect the height to which the atomic cloud will rise as well as the rapidity and location of the radioactive deposit. In the case of under or over water explosion, tides and currents will affect the speed with which the contaminants will be disseminated.

Fall-out contamination of a surface ship presents a combination of internal and external hazard to personnel and consists of unfissioned particles of the metal of the bomb as well as fission products. Early, following contamination, external body radiation will be of most serious importance as most of the fission products have relatively short lives but those which have long

life will continue to be important internal radiation hazards long after the beta and gamma emitters have decayed to a negligible level.

The hull of a ship may become contaminated as a result of sailing in contaminated waters. This type of contamination will first be noted on the underwater body surface of the ship particularly around the green sea growth at the water margin. Crustaceans and algae have been found to have the faculty of concentrating the activity from the water and barnacles become particularly "hot." It will be found soon, also, that salt water lines and, particularly, condenser lines, will be radioactive, the scale in the lines apparently concentrating the activity much the same as the marine growth does.

An additional and very important type of contamination consists of recontamination and is the result of the carrying in of radioactive materials to otherwise "clean" areas. Personnel who have been directly contaminated and those who have had access to contaminated areas are likely to carry this contamination on their feet, hands, or clothing, or on articles of any kind which they have attempted to salvage from the contaminated area.

This is to be avoided if at all possible and necessitates the wearing of protective (the word protective does not imply protection against radioactivity but only protection of the individual against contamination with radioactive materials) clothing by rescue parties, the removal of "hot" clothing and, if necessary, repeated bathing before coming from a contaminated to a clean area. Extreme vigilance and careful and constant monitoring is essential.

EFFECTIVE RANGES

The estimation of probable casualty production at the time of an atomic bomb explosion.—For the purpose of planning, the approximate ranges within which injuries to personnel could be anticipated for the various types of hazard, are given. When the bomb is detonated in the air or on the ground (surface), injuries may be expected within these ranges:

	Yards
Blast (direct, unshielded)	1,300–1,500
Blast (indirect effects)	3,000
Radiations (instantaneous):	
Infrared	3,000
Ultraviolet	2,500
Visible light	10,000
Ionizing radiation	2,000
Neutrons	1,000
Fission products	[1]
Nonfissioned material	[1]

[1] Wide distribution in air.

For planning purposes, many casualties would be anticipated among personnel exposed in the open within 3,000 yards of an air burst bomb. While ordinary buildings would provide some protection against flash burns, they would provide relatively little protection against ionizing radiations and might increase the chances of indirect blast and fire casualties due to falling and burning of buildings. An estimate of the number of casualties in an air burst would be one-third immediate deaths, one-third early deaths and one-third serious casualties requiring much medical attention. This would include all personnel within the 3,000 yards range.

Whereas personnel in ships would receive some benefit from shielding from gamma rays, this number would probably be offset by an equal number being injured by effects other than those calculated here. This would not include casualties which might arise subsequently from personnel being exposed to residual radioactivity due to their entering contaminated areas or their being exposed indirectly to this subtle hazard.

In no instance does this take into account the adverse psychologic effects to personnel which can certainly be estimated to be serious and which may indeed prove to be a major concern. This will depend very much on how well these effects can be minimized by adequate indoctrination, smooth organization and leadership. It is impossible to make a good estimate of this phase of the antipersonnel effect.

Field Instruments for the Detection of Ionizing Radiation

General.—The detection and measurement of high energy ionizing radiation depends entirely upon suitable instruments and photographic film. Without these, even intense radiation will not be recognized until serious damage has been done. The three radiations, alpha and beta particles and gamma rays, cannot be detected and measured with

equal facility. Alpha particles, because of their short range, will not be measured with the usual portable instrument. Beta particles and gamma rays can be determined with a single Geiger tube instrument; by opening a window in front of the tube both radiations will be measured, but only gamma will penetrate with the window closed. Most portable ionization chambers are designed to measure only gamma rays since constructional strength would be lost if thin walls were used which would permit beta particles to penetrate into the ion chamber. The same is true of electrometers and electroscopes. The essential requirements of a field instrument are portability, ruggedness and dependability. It must be simple in operation so that personnel can be rapidly trained in its use. It must be so designed that repairs and replacement of parts can be accomplished in the field. The instruments at present available for survey work fall into four groups. The following are some of the general characteristics of existing instruments:

Geiger counters.—These instruments have been developed for field use as small as 250 cubic inches and with a weight of only 2 to 4 pounds. This instrument contains its own portable batteries. In most designs earphones are provided for audible detection in addition to a meter for scale readings. The scale has a range of from 0.001 to 0.5 roentgens per day, but by means of the earphones it is possible to measure intensities about one-half or one-fifth as great. Thus this instrument is a ratemeter for measuring low levels of radiation. It is usually designed with a window so that when the window is closed, only gamma rays are detected, and when the window is open both beta particles and gamma rays can be measured.

Ionization chambers.—Ionization chambers have been developed for field use with a volume of about 1 cubic foot and weighing about 17 to 20 pounds. Some of the present models have three scales covering a range for 0.1 to 200 roentgens per 24 hours so that this instrument is used when high intensities are being measured. The present chambers are designed to measure only gamma radiation.

Electrometers.—As contrasted with Geiger tube and ionization chamber instruments which are ratemeters, the electrometer measures total radiation. It is commonly called a dose meter or dosimeter. Common types are small (100 cu. in.) and light (2 to 4 pounds), and they have an integral battery supply which charges plates in a detachable moistureproof chamber. A sensitive voltmeter measures the charge on the plates which decreases through ionization by radiation entering the chamber. This instrument measures gamma radiation and is calibrated to read roentgens directly. It can be carried into the field and will indicate the total amount of radiation (dosage) to which a person is exposed in its vicinity.

Electroscopes and film badges.—The field adaptation of the electroscope is a small pencil sized tube with no integral voltage supply. It is initially charged by a battery which orients a thin quartz fiber within the tube. As this charge diminishes through ionization by radiation, a thin fiber moves across a scale which can be viewed through a small end window in the tube. The scale divisions traversed by the fiber can be converted into roentgens. The instrument can easily be carried in a pocket and will supply continuous information concerning the accumulated radiation exposure (dosage) of its wearer. It is therefore, a dosimeter, and is sensitive only to gamma radiation, unless the chamber is made permeable to beta particles as well. It is usually made so that 0.1 roentgen will produce about one-half of scale deflection.

A valuable supplement to the ratemeter and dosimeter is the film badge. Photographic film is sensitive to beta particles and gamma rays; in addition, by treatment of the emulsion with dye and addition of boron, it can be made sensitive to alpha particles and neutrons. The film, in the form of a badge, about 1 by 2 inches, can be worn by personnel or placed in areas where radiation exists or may be expected. It also contains a lead cross to intensify the gamma radiation. It provides an accurate and permanent record of total exposure and therefore may be regarded as a dosimeter. It is easily handled and calibrated and requires no complicated electrical equipment.

These are only a few of the tools of the "Monitor" whose duty it is to detect and report the hazards, their location, and intensity. The electroscope and the film badge are worn by personnel likely to be exposed to ionizing radiation and measure the total radiation to which the individual

has been exposed during the period they have been worn. The electroscope may be read directly at any time whereas the film must be processed by methods similar to that used in developing X-ray films. The density of the film is proportional to the amount of exposure it has sustained and this is accurately measured by photo-electric methods using a so-called "dosimeter." The electroscope and film badge are normally worn simultaneously and act as a check on each other. There are many other types of detectors but most of them are not field instruments. Monitoring is not usually the duty of medical personnel.

Calculation of Risks in Connection With Radiological Hazards

In the event of atomic warfare, commanding officers may be forced to accept certain calculated risks in a manner similar to that of other dangerous military operations. In this respect the problem is essentially no different although certain techniques make the calculation more satisfactory than in operations not involving radiological safety. This calculation can be employed only in connection with the entry into, or the occupation of contamination areas. The basis for the calculation of the risk will be:

Radiological survey of the area or the individual site. It may apply to collective safety as far as a unit of troops is concerned or the specific hazard to which a rescue party may be exposed in the conduct of its mission.

The consultation of the RadSafe officer with the medical officer and the presentation to the commanding officer of the recommendations arrived at from the analysis of the radiological survey.

A scale indicating probable injurious effects of various doses of exposure. There are many factors to be considered.

Time After Detonation

Radioactivity will be most intense shortly after the detonation and will decrease markedly the first day, generally in accordance with a regular curve, as previously noted. The residual effects from an air burst will be practically nil. In the case of the water burst, however, entry into or occupation of the areas of contamination would require a particularly careful calculation of the risk because of the greater inherent danger of high and persistent residual activity. Several months after a detonation of this type, the danger of internal radiation is likely to be more serious than the hazard of external radiation. The estimation of the alpha hazard is much more difficult (as previously noted) and requires very special techniques. A number of specialists and a great deal of time are required to make these estimates.

Unless survey data is reliable, proper calculations of risks cannot be made. This requires that good judgment be employed not only in assessing the intensity of the hazard but also in interpreting the reliability and the suitability of the data presented. This will necessitate the employment of personnel who are properly trained and technically and personally reliable. Instruments must be reliable and their use must be in accordance with standard procedure.

In the absence of any or all of the above, the problem of calculating the risk may be insurmountable. In this event, it is best to assume conditions of relative safety if it is an air burst of the Japanese type, and so serious as to contradict entry or occupation if a surface or water burst of the type seen in New Mexico or Bikini. In the latter, only the gravest and most vital mission could be entertained since the risk would be so great as to put the venture in the nature of a suicide project.

Dosage of Exposure and How Employed in Calculating Risk

The importance of the "time and concentration" factors, and the importance of "total amount of radiation received" in total body radiation has already been mentioned. It is worth-while to repeat that 0.3 r/weeks (roentgen per week) is the maximum total radiation which can be received with safety. The total dosage, then, is calculated by measuring the intensity of radiation at a given site or in a given area, and introducing the time relationship into the calculations in such a manner as to indicate the allowable time in that particular area.

For example, the intensity at site A, according to the reading of a reliable meter, is 100 r/day; in 24 hours, an individual would receive 100 roentgens; in 12 hours, 50; in 1 hour 4; in 15 minutes, 1 roentgen, etc. Thus an individual would receive

10 times the maximum allowable dose of exposure in 15 minutes in area A.

In a controllable situation, the pocket dosimeter (electroscope) and the film badges are worn. If either or both of the devices should indicate that the individual wearing them had been exposed to 0.4 roentgens during any given working day, it would be necessary to remove him from any area containing radiation hazards for a minimum period of 4 days. In cases of marked overexposure, the following table may be used to estimate the result, assuming that the overexposure has been accumulated over a relatively short period such as several weeks.

0.3 r./week	Maximum safe exposure (for constantly exposed workers).
0.1 to 10 r. acute exposure	Relatively little risk.
10 to 50 r. acute exposure	Some slight injury likely but probably subclinical.
50 to 100 r. acute exposure	Injury practically certain, probably not incapacitating.
100 to 300 r. acute exposure	Serious injury becomes frequent, some deaths practically certain but may be delayed.
300 to 600 r. acute exposure	Serious injury or deaths certain, very serious incapacitation, some may linger for weeks or months requiring extensive medical attention and even die.
600 to 1,000 r. acute exposure	Death certain, often in first few days.
Above 1,000 r. acute exposure	Death certain, often in a matter of hours.

Internal Body Radiation

The maximum quantity of radium-like material which may be safely ingested as established by Manhattan Engineer District scientists is one (1) microgram (one-millionth part of a gram) in an entire lifetime.

MEDICAL ASPECTS OF AN ATOMIC EXPLOSION

An atomic explosion, regardless of its location, will result in four types of effects:

1. Thermal radiation (thermal blast).
2. Air blast.
3. Solid blast.
4. Ionizing radiation (radiation blast).

The first three will vary only quantitatively from similar blast effects of other forms of explosion frequently encountered in preatomic warfare, but the fourth, however, is new and has no close prototype with which we are at all familiar.

This offers but a poor conception of the problems which arise and of the biological changes which follow total body radiation with neutrons, beta particles, gamma rays and alpha particles from the ingestion or inhalation of radioactive materials.

Thermal Effect

Thermal radiation refers to the radiant energy of the atomic explosion and does not include the effects of secondary fires or explosions which may be the result of the detonation. At the moment of detonation immeasurable degrees of heat and light are produced. Both the infrared and ultraviolet rays are capable of producing severe burns to the body surface, especially to exposed surfaces of the skin. The thermal energy is, however, of very short duration and, although it may account for a high proportion of the casualties near the center of the detonation because of its extreme intensity, a relatively small amount of shielding offers considerable protection. Even light clothing, especially if glossy surfaced, offers complete protection in many cases. Dark colored materials, on the other hand, were frequently found among the Japanese where the skin was burned in a regular pattern depending upon the color and consistency of the clothing which had been worn at the time of the blast. It has been estimated that between 20 and 30 percent of the fatalities at Nagasaki and Hiroshima were the result of flash burns.

Air Blast

The primary type of air blast injuries are produced by the passage of the pressure wave through the tissues causing actual structural change and injury or death. These effects are exerted chiefly at interphases between air and solid, as the lungs, the intestines and the stomach. Except for individuals in close proximity of the blast, the primary effects are of little importance. At ranges where they might be considerd dangerous, other factors

would be of more importance as casualty producers. That is, an individual well beyond the limit of danger from primary air blast might still receive many times the lethal dose of radiation.

Solid Blast

The secondary air blast effect is far more important than the primary. Casualties are produced by (*a*) the structural collapse of buildings, (*b*) flying debris, (*c*) the effect of being hurled against solid or semisolid substances. All of these injuries would be essentially the same as those produced by any heavy air blast.

In an underwater detonation, the energy transmitted through the water would cause injury to personnel in the water at the time and within the concussion range. An individual completely submerged is able to withstand many more pounds of pressure per square inch than one partially submerged. In the latter, rupture of the hollow organs is much more likely to occur. The exact range at which this type of casualty may be produced is not accurately known but it is much less than would normally be imagined, according to preliminary reports of research on the subject.

Ionizing Radiation

Individuals exposed to injurious dosages of these radiations present a variety of clinical conditions. Important in determining the clinical expression of the changes produced is the manner in which the injurious agent is brought to bear on the individual. Exposure of the external surface of the body to penetrating ionizing radiations and neutrons causes quite a different set of clinical findings from that caused by the injurious effects of internal body radiation. While there is some general relationship among the causative factors in that they belong to a group of related and interesting physical incitants, the clinical picture as a whole is usually more characteristic of the form of exposure than of the intrinsic characteristics of the injurious agent. Some of the clinical findings may be similar but the clinical picture as a whole is usually quite different. The classification presented is an arbitrary one and is aimed primarily at providing a terminology suitable for clinical diagnostic purposes.

Radiation sickness is the illness produced by overexposure to penetrating ionizing radiations and neutrons. Systemic reaction, in this instance, arises from exposure of the external surface of the body to penetrating radiation. Gamma rays, X-rays and neutrons are the more common causative agents. The injurious dosage may be received instantly or may be accumulated over a period of time. The onset of symptoms may be abrupt or insidious. In the acute form as observed at Hiroshima, it may be fulminating, occurring with sudden severity. In the mild forms observed after roentgen therapy, the symptoms are usually transient. One particularly subtle form sometimes seen is the leukemia which occurs in radiologists after years of repeated exposure to low grades of accumulating dosage of X-rays. The exact mechanism by which ionizing radiations and neutrons produce injury in living cells is not known. Nor do we have specific therapeutic measures which can be employed to counteract the injurious effects of irradiation within tissues.

Factors Influencing Radiation Exposure

Radiosensitivity.—Tissues particularly susceptible to radiation injury are described as being radiosensitive and those least sensitive as radioresistant.

There is considerable variation in radiosensitivity among species, organs, and cells.

Species.—The guinea pig and the rat are much more sensitive and the goat about equally sensitive with man. Fish are much less sensitive to radiation than man. As a consequence, the results of animal experimentation are not always directly applicable to man.

Organs.—The lymph glands, the bone marrow, the testes and the ovaries are the most sensitive organs. The hair follicles are more sensitive than the surrounding layers of skin. The brain, characterized by an extremely highly organized cellular tissue, is peculiarly resistant to radiation, the muscle tissue is somewhat less resistant.

Cells.—The more immature a cell, the more radiosensitive it tends to be. The most sensitive cells in decreasing order of sensitivity are lymphocytes, germinal cells of testes and ovaries, granulocytes, platelets and erythrocytes. The formed elements within the circulating blood are slightly less sensitive than those within the hematopoietic (blood making) tissues. Somewhat less sensitive than any of the preceding cells are cer-

tain epithelial cells. As a consequence, blood studies provide the earliest and most reliable information about radiation sickness.

Genetic effects.—It has been known since the early days of X-ray that ionizing radiation can produce sterilization; sterilization on a large scale was seen after the atomic blasting of Japan. Ionizing radiation can produce sterility as a primary effect but not impotence. Impotence, when it occurs in connection with radiation is a by-product of the various debilitating effects of severe radiation illness. Sterility is often temporary. Pregnant women who were victims of heavy dosage in Japan did not bear monsters; abortions and miscarriages were the result. In regard to future generations. geneticists point out the following:

Ionizing radiation in sufficient dosage can cause an increase in mutations, a sudden noninherited change of form, or characteristics, largely recessive.

Most mutations are detrimental and will often result in obscure physiological weaknesses rather than spectacular or bizarre malformations.

The cellular changes which are observed in tissues injured by radiation are not in themselves characteristic or peculiar of radiation injury. As a matter of fact there may be a close similarity between the cellular changes produced in trauma, such as thermal burns, chemical poisons, infections, and extremes of malnutrition. Quite naturally, tissues vary in their response to insult by these various agents. No single agent other than radiation produces the same type of injury in the same diversity of tissues in the same individual. The changes produced in like tissues of different individuals may be so alike as to be indistinguishable and yet the injurious agents are quite different.

Radiation injury is the localized injurious effect. The incitants may be alpha or beta particles, gamma rays, or X-rays. The onset is usually insidious. Some forms of radiation injury may be associated with radiation sickness, such as the epilation of victims. Other examples are precancerous lesions of the skin from prolonged and repeated exposure of a particular area to radium or X-ray, sterility from exposure of testes or ovaries to X-ray, and changes in the nails and fingerprints from prolonged exposure locally to radium or X-ray.

Radioactive poisoning is the illness which results from radioactive materials gaining access to the body. Here, they act as an internal poison producing localized or systemic effects or both. The offending radioactive poisons are materials which emit nuclear particles (alpha or beta) or nuclear radiations (gamma). The former, in spite of their short range, are of particular importance in this connection because of their high density of ionization. The onset is usually insidious, often subtly, and at times indeed it may be years after the original exposure. Examples of radioactive poisoning are the radium dial painters illness and poisoning due to drinking radioactive waters.

Severe exposures—Earliest deaths.—In the most severe cases, death may occur within a few hours. Severe weakness and prostration, a state of extreme shock and a dulled sensorium (a common center of sensations) with few other symptoms. There may be fever. The exact mechanism of injury and death in this type of case is not understood. The clinical picture, however, is clear-cut, and the prognosis completely bad. This type of severe exposure had rarely been seen in the human prior to the Hiroshima incident.

Severe exposures—Death during the first week.—Individuals severely exposed but not as severely so as those just described, are likely to present varying degrees of shock, even within a few hours of the incident. Anorexia (absence or loss of the appetite), nausea and vomiting, fever, and weakness and prostration may be the outstanding findings on the first day. There may be no evidence of skin injury. Pain and suffering are likely to be absent unless there is concomitant illness or injury. The sensorium is dulled and the individual is more likely to be apathetic than agitated. Death may occur on the second or third day.

Blood counts taken a few hours after exposure may reveal a decrease in total leucocyte count and this decrease will invariably be noted on the second day. Before death, the count may drop to 500 or below.

There may be a bothersome diarrhea beginning on the second day, rarely before. This will become progressive if the individual survives beyond this time. The diarrhea will be watery early but will tend to become bloody.

Late in the first week, secondary infection and a tendency to spontaneous bleeding will become serious complications. Severe angina (a sense of suffocation) is not uncommon at this time. There may be ulceration of the tonsils, of the mucosa of the large intestine and of the labia in women. In general, the earlier the appearance of systemic reaction, the more grave the prognosis. The same is true of an early depression of the leucocyte count. Complications are of utmost importance but difficult to evaluate.

Severe exposures—Death after the first week.—In individuals who survive the first week the initial symptoms are not likely to be so severe or as early in their appearance. White blood counts will reveal an early suppression of lymphocytes followed by a decrease in the granulocytes. The total white blood count may fall to less than 500. After the third or fourth day, a tendency to bleed may be an outstanding feature, and may be an important factor in determining the outcome. Hemorrhage may occur into any organ or from any membrane.

Bleeding from the mouth, and gums, intestinal bleeding, and hematuria are to be expected. There may be petechial hemorrhages into or under the skin, into the retina, the myocardium, or the cerebral tissues. This hemorrhagic tendency is associated with (*a*) a reduced number of platelets, (*b*) possibly some humoral (pertaining to the natural fluids of the body) disturbance, and (*c*) increased capillary permeability. The reduction of platelets and increased capillary permeability can be observed objectively.

During the latter part of the first week and thereafter, various forms of secondary bacterial invaders may complicate the picture. Due to the suppression of the lymphocytes and granulocytes and to the destruction of lymphoid tissue there is a markedly decreased or completely absent resistance to infection. This may result in invasion of the intestinal mucosa by the normal intestinal flora, in bacteremia, boils and carbuncles, ulceration of the tonsillar areas and angina with marked necrosis of the pharyngeal tissue. Such lesions may reveal no lymphocytic infiltration, only macrophage (large nucleated lymphocyte) type of cells.

In cases of thermal burns or other skin injuries, the secondary infection seriously delays healing and promotes the formation of scar tissue. This may become luxuriant and unique in its characteristics. It resembles keloid (a fibrous growth) and it is thought that this scar tissue may in the future become malignant.

In a patient who survives the first week, there is very likely to be a profound anemia which will be the result of a combination of failure of the erythropoietic (red blood forming) tissues and loss of blood. Both the red blood count and the hemoglobin will be reduced. In the more severe cases, there appears to be a complete paralysis of all marrow function and the clinical course and the blood picture are similar to those found in fatal benzol poisoning.

Ingestion type of radiation.—The symptomotology, prognosis, and treatment of the condition which results from the aspiration or ingestion of radioactive material are identical to those observed in the cases which resulted in the radium dial painters.

Recovery and convalescence.—The more severe the illness, the longer recovery is likely to require. In the casualty and death producing ranges of exposure, there is little individual variation and husky persons are not more resistant to the radiation than the less robust. However, in cases of less intensive exposure where secondary infection, hemorrhagic tendency, etc., are so common as to be considered an integral part of the clinical picture, constitutional endowment, age, and some secondary external factors may be of great importance in determining the outcome of the individual case. Resistance to infection, local or generalized, is a variable factor and depends in part on the individual's resistance. and in part on the characteristics of the invading organism, the response to specific therapy, etc. Changes in the intestinal tract may seriously hamper the assimilation of food and produce severe states of malnutrition. The intractability of the diarrhea may assume very serious importance.

No definite course of convalescence can be predicted. The more severe the combination of complicating factors, the more difficult and protracted the convalescence. Individuals who do not become ill during the first two weeks are not likely to become ill at all. Those who do become ill but are able to survive the sixth week are very likely to recover. The time element involved and the

therapeutic difficulties which might be encountered are impossible of prediction.

An individual who has received enough general body radiation to produce erythema (a superficial redness of the skin) is quite certain to die of acute radiation sickness. The hair follicles are much more sensitive to radiation than the skin and it is possible for epilation to be produced by smaller, nonlethal doses. Hair will be lost over the area exposed to radiation, and the loss may be unilateral (on one side). Epilation may occur prior to death in cases of fatal exposure when death occurs late in the illness. In Japan the peak of the death curve occurred during the third week and fell gradually until the sixth week. Those who survived the sixth week had a relatively good chance of recovery; most of the deaths subsequent to that time were caused by secondary infections and attributable to the impossibility of asepsis and antisepsis under the conditions which existed.

Overcompensation of the blood cells during convalescence.—Occasionally, patients who have survived the first week of illness will be found to present an elevated leucocyte count as well as an increase in the hemoglobin and the total red cell count. The white-blood count may be 15,000 to 25,000; the red-blood count, 6 to 6.5 million; and the hemoglobin, 110 to 125 percent (Sahli). The elevated white-blood count is not necessarily evidence of infection. In these cases, the differential count is thought to be of utmost importance. A count of less than 0.5 percent reticulocytes indicates a poor prognosis and one of over 1 percent supports a good prognosis.

The irradiation may cause either an increase or a decrease in the total count and may be confusing. Severe acute exposures will cause a decrease; as recovery occurs this will be followed by an increase over the normal count. Low-grade chronic exposures produce an increase in the count unless the total accumulated dose is of such magnitude as to depress the function of the bone marrow. A few cases of this type were found among individuals living within an area where there had been an accumulation of "fall-out" of radioactive materials. This same type of repeated exposure to X-ray is thought to account for the fact that leukemia is ten times more common in radiologists than in individuals not so exposed to radiation.

TREATMENT

Early treatment of survivors is likely to be impossible because of the difficulty of getting to the bomb victims, the probable lack of functioning medical facilities, and the lack of availability of trained personnel and of proper instruments and material.

Measures To Be Applied in the Field Before the Casualty Is Removed to a Medical Facility (Aid Station, Emergency Hospital, Etc.)

1. **Do not** needlessly expose rescue or aid party personnel to grave external radiation hazards. Do not attempt to remove patients to a "clean" area for treatment until decontamination has been accomplished to a safe degree.
2. **Protect against shock** and administer simple life-saving measures to acute cases where such is indicated and the situation permits.
3. **Transport to proper aid station** or hospital as soon as possible. Do not attempt transfusions or intravenous procedures forward of the aid station. Remember the dangers of infection.

Measures To Be Applied in the Aid Station

1. Continue to protect against shock.
2. Administer such life-saving measures as may be indicated by good medical judgment and permitted by the situation.
3. Select for whole blood transfusion only those cases in which medical judgment would indicate that some benefit could be derived. Cases which have obviously received massive over-dosage of radiation, transfusion and heroic treatment is **not** indicated. Decisions will be difficult to make but, in case of an atomic disaster, it is most probable that trained personnel and all material (including whole blood) will have to be rigidly rationed, conserved, and expended only on those who have reasonable expectance of recovery.
4. If possible on the second day, select cases for further intensive care on the basis of white-cell counts provided other hopeless findings are not overriding. If a patient has a total count of less than 2,000, he should **not** be further transfused. If over 2,000, he should be selected not only for transfusion, but for the best medical and nursing

care that it is possible to provide. If, on the third day, the count has increased to 5,000, the chances of recovery are good, but, if there has been a further decrease, the chances of recovery are nil and no further expenditure of critical supplies is warranted. Total white-blood count, is then, a guide for prognosis at this stage and indicates those individuals who could be selected for "all out" treatment and those for whom treatment would be wasted.

General Considerations Applicable Particularly After the Second Day

1. Good nursing care, asepsis and antisepsis.
   (i) Hygiene of the mouth and skin.
   (ii) Avoidance of parenteral treatments if possible.
2. Penicillin and sulfonamide medication, orally if possible.
3. Streptomycin in cases of B. Coli invasion or bacteremia.
4. Whole blood transfusions as indicated by blood studies.
5. Folic Acid and Liver Extract to support the transfusions.
6. Possibly, the administration of blood coagulants, Vitamin K preparations, Congo Red, etc. The use of these preparations in man has not been investigated but they may be found to be of some value.

The following is the final paragraph of the "Report on the Medical Studies of the Effects of the Atomic Bomb" by Dr. Masao Tusuzuki, Professor of the Tokyo Imperial University and chairman of the Medical Section of the Japanese National Research Council:

> The most important measures for the treatment of the atomic bomb-radiation injuries is careful protection. All patients are affected more or less by the radioactivity; these must recover by their own vital power. In the cases in which the vital organs are damaged beyond their ability to recover, **medical care at the present time cannot help.** We may have some hope of recovery as long as any reserve power is remaining because the radiation exposure has occurred only once. We must, therefore, avoid such treatment as whipping a tired horse hastily. In other words, we should not be overconfident in the ability of our medical care. Our aim shall always be a promotion of the natural healing powers.

Tolerances.—Although the term "tolerance" is used in reference to dosage of radiation there is no proof that living tissues are actually tolerant of ionizing radiation, even in the minute amounts everywhere present as "background." The term "maximum permissible exposure" is also in general use by many authorities and is probably the better of the two terms.

Tolerances do not represent limits within which there can be complete disregard of exposure. The aim must always be to avoid all radiation to the greatest possible extent.

In the practical application of tolerance levels such factors as efficiency of the instruments used for determining the hazard present, geometrical considerations, and calibrations must be taken into account. Otherwise great discrepancies are apt to occur.

The following tolerance levels apply for work with radioactive objects and materials, or in all radioactive areas.

External radiation.—The tolerance level for total or limited body exposure is 0.3 rem (roentgen equivalent man) in any 1 week. The 0.3 rem represents the total additive exposure from the independent components of all ionizing radiations involved, including X-rays, gamma rays, neutrons, and beta rays.

Internal radiation.—No amount of plutonium or a similar alpha emitting element is ever considered tolerable. A total of one microgram of plutonium or a similar element deposited in the body is considered a lifetime tolerance. Regulations governing permissible radiation levels in food and water supplies will be published at a later date. Pending such instructions, no food or water known to be or suspected of being radioactively contaminated, shall be consumed.

Personnel Requirements

It is necessary that the least possible number of persons required for efficient execution of any given task in a radioactive area be employed with a view of minimizing the exposure of each individual. However, in any radioactive area a sufficient number of personnel must be employed to assure that no individual shall be exposed to more than 0.3 rem per week. In the event of accidental exposure in excess of this amount it will be necessary for the individual to be absent from further exposure until sufficient time has elapsed to reduce the total exposure to the permissible amount. Per-

sonnel exposed to ionizing radiation hazards, no matter how minimal, over long periods of time, should be granted a continuous period of 30 days each year during which no exposure will be incurred. This period should coincide with vacation leave when possible.

All persons other than military personnel and civil-service employees who are permitted to board any radioactive vessel or to enter a radioactive area under naval cognizance shall be allowed to do so only after signing a statement that they have been warned as to the presence of radiological hazards. Compliance with all safety regulations shall be required of such individuals during their visit, including use of protective clothing, devices, and procedures as indicated.

Medical Examinations

Pre-examinations.—All personnel, both civilian and military, who enter radioactive areas or who board a radioactively contaminated vessel, will be required to have a complete physical examination prior to commencing such duty. These examinations will be conducted when practicable by Radiological Health Officers. The examination will include a complete blood count, a sedimentation rate, urinalysis, and chest X-ray. The X-ray of the chest may be made by any available technique including 35 mm. microfilm. A record of fingerprints of all fingers will be made.

Physical requirements.—Because the work in radioactive areas may require a certain amount of physical endurance and agility and involve the wearing of masks and cumbersome clothing as well as vigorous personal decontamination, it is believed that only personnel without gross physical defects should be employed. Those civil-service personnel who would be classified as being able to perform **arduous** work under the routine Civil Service examination, or those service personnel who are fit for **active duty** may be considered qualified for this work as regards their general condition. Personnel not so qualified, whose services are essential to an operation may be accepted upon approval of the Bureau of Medicine and Surgery.

In addition to the general physical requirements of the preceding paragraph, the following findings are considered disqualifying for work entailing possible exposure to ionizing radiation.

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Skin

All open wounds, whether cuts, abrasions, ulcerations, or inflammations, until healed.

All conditions in which there are open or raw surfaces or external roughened areas in which foreign bodies may be deposited or which the examiner believes may be aggravated by irradiation.

Excess longitudinal corrugation and brittleness of the nails.

Atrophic skin conditions.

Severe chronic blepharitis (inflammation of the edge of the eyelids).

Eyes, Ears, Nose, and Throat

Any severe infection, acute or chronic, of the eyes, ears, nose, or throat.

Markedly enlarged tonsils.

Allergic conditions of the nose or nasal sinuses, if active under working conditions.

Mouth

Pyorrhea, or extensive pocketing of gums.

Severe dental caries.

Severe gingivitis or stomatitis.

Any open lesions.

Precancerous lesions, including leucoplakia (the formation of white spots or plates on the epidermis or epithelium).

Respiratory System

Any acute or chronic infection.

Acute exacerbations of respiratory allergies.

Cardiovascular and Blood Systems

Total white count below 4,000 or above 12,000. (In cases where abnormal white cell count may be due to transient diseases or other conditions, re-examination should be made upon recovery.)

Persistently abnormal differential count.

Total red blood count below 3.5 million or above 6.5 million.

Sedimentation rate persistently above 15 mm./hr. (Cutler or Wintrobe).

Genitourinary System

Any acute or chronic urinary tract disease.

Any persistently abnormal urinalysis.

General

Any precancerous disease.

Changes in fingerprints, indicative of atrophy.

X-ray Findings

Evidence of active infectious process or of bronchiectasis (dilatation of the bronchi).

Evidence of changes secondary to respiratory allergies.

Evidence of intrathoracic neoplasms (new growths or tumors).

Recording of Examination

The results of these examinations will be recorded: The physical examination on the Report of Medical Examination—Standard Form 88, the laboratory data, the chest X-ray report, the fingerprint record on the appropriate forms. Each fingerprint will be labelled. All forms will be prepared in duplicate. A statement will be entered under "remarks" on each Report of Medical Examination—Standard Form 88 giving the known total previous exposure to radiation and the type of work being performed. The original copies of all papers for each person examined will be firmly fastened together and will be forwarded to the Atomic Defense Division, Code 74, Bureau of Medicine and Surgery. The X-ray film will be retained at each activity and kept in a permanent file. The duplicate of each examination will likewise be securely fastened and filed at the local Radiological Health Headquarters.

In the case of Army personnel attached to the activity, prepare and forward one additional copy of the completed examination to the Atomic Defense Division, Code 74.

Civilian personnel records will be handled as are those of Navy personnel. A statement that a special radiation examination was given as provided for shall be entered in the corresponding person's health record, with the date of the examination. An abstract of the examination will be entered in the special radiation abstract of the health record when these special sheets become available. These abstracts are to remain in each health record for the duration of service of all personnel involved.

Follow-up Examination

All personnel working in a radioactive area will have a monthly follow-up examination. Examiners will be alert for signs of chronic radiation sickness; as lack of vitality, loss of appetite, weight loss, cracking of the skin of fingers, and excessive longitudinal corrugation and brittleness of the fingernails. Complete blood counts and an erythrocyte sedimentation rate will be made at the time of the pre-examination, and at such other times as the radiological health officer may require. All blood samples should be obtained under similar conditions, under similar technique and at the same time of day for each individual. By so doing, it is likely that the effects of physiological variation in the composition of the blood will be minimized. Since a variety of changes is possible in the blood picture after exposure to radiation, all blood counts will require, in addition to very careful laboratory technique, interpretation by a medical officer who is a radiological health officer or one who is experienced in such work.

Individuals presenting persistently abnormal findings should be removed from all exposure to radiation, and be given an exhaustive study, preferably in a Naval hospital. This should include bone marrow studies and alpha and beta counts in the urine, and chemical analysis of the urine for radioactive and toxic elements. Care must be observed in the evaluation of abnormal findings, and the general physical condition of the patient at the time of the examination must be considered. Transitory illness or ailments, or concomitant diseases, must be noted. Known overexposures or cases of possible radiation sickness should always be transferred to a Naval hospital for study.

The follow-up examination will be complete, except as follows: The dental examination need not be repeated if all teeth are absent and the mouth is otherwise normal. If all teeth are normal on the first examination, follow-up dental examination may be omitted unless indicated. Other portions of the examination, as measurements, may, at the discretion of the radiological health officer, be deleted. In all cases of deletion, a statement must be made on the appropriate line of the examination report justifying the omission.

The chest X-ray and fingerprints shall be repeated at 6-month intervals, and upon completion of the individual's duties in radiation work. In cases of radiation sickness or overexposure, chest X-rays and fingerprints will be taken as indicated.

Wherever possible, follow-up examinations should be made at 6-month intervals for a period up to 5 years of all personnel whose duties have involved repeated exposure to radiological hazards.

THE RADIOLOGICAL HEALTH OFFICER

Mission

Under the commanding officer to establish, develop, and execute plans for safeguarding the health of personnel engaged in all operations involving exposure to radiological hazards.

Tasks and Functions

1. To serve as principal adviser to the commanding officer in all matters pertaining to the medical aspects of radiological safety.
2. To maintain sufficiently close contact with the operations conducted so as to be able to evaluate all radiological hazards.
3. To conduct the radiological health program in such a manner as to support the over-all Radiological Safety Plan of the command.
4. To conduct medical examinations and otherwise to observe the health status of personnel engaged in all operations involving radiological hazards and of all personnel prior to and upon completion of their assignment to such duty.
5. To provide such health monitoring, including photographic dosimetry, as may be necessary to ascertain the degree of radiological exposure of personnel.
6. To provide such medical supervision as may be required in effecting the decontamination of personnel who have been in contact with radioactive material, and of their clothing and individual equipment.
7. To maintain a system of regular inspection of all radiological safety arrangements in order to assure complete compliance with all local safety requirements and with those established by higher authority.
8. To provide immediate care for personnel who may be injured while engaged in any activity involving exposure to radiological hazard.
9. To make adequate arrangements for definitive medical care and treatment as necessary for personnel who may have received any radiological injury.
10. To supervise the professional and technical work of all medical and other personnel under his cognizance.
11. To report to the commanding officer as well as to the Bureau of Medicine and Surgery any serious infractions of radiological safetey discipline and violations of radiological safety regulations.
12. To advise the commanding officer in the preparation of radiological safety regulations applicable to the command.
13. To maintain adequate records as required by local regulations and by higher authority and to submit all reports of radiological health operations required by the Bureau of Medicine and Surgery and other higher authority.

The radiological health officer of each activity concerned shall submit the following regular reports via official channels to the Bureau of Medicine and Surgery:

A weekly inspection report.—In letter form of all radiological safety arrangements including change in station facilities.

A monthly photographic dosimetry report of all exposed personnel including in columns, name, rate, number of days employed to date, total time exposed to date, total gamma received to date, total beta received to date. In the event that any individual has received an exposure in excess of 0.1 rem in any 24-hour period, the circumstances connected therewith shall be explained as a part of the same report.

A monthly roster of all personnel (medical) on duty with the Radiological Health Section.

FIRST AID

All wounds sustained in a radioactively contaminated area, regardless of their severity, shall be treated immediately in such a manner as to prevent absorption of the radioactive material which has been deposited into the wound. Generally this is best accomplished by stimulating a mild bleeding by means of manual pressure or by placing a tourniquet above the wound. At the same time the wound must be washed with soap and copious amounts of clean water, which must be kept available for this purpose. The injured person should then be evacuated to a change station or decontamination center where the radiological health officer will determine the appropriate disposition

of the case. The formalities of complete decontamination of the injured person is not to be permitted to interfere with urgently indicated medical or surgical treatment, but may be deferred until they can be carried out without jeopardizing his general welfare.

THE BURN PROBLEM IN ATOMIC WARFARE [1]

An atomic explosion is accompanied by the release of enormous quantities of kinetic energy, at least 80 percent in the form of ordinary heat—commonly recognized as infrared, visible and ultraviolet radiation. It is now well known that the temperature in the immediate vicinity of the bomb burst may rise to several million degrees; the biologic importance of the thermal component of an atomic bomb explosion has been largely obscured in the lay and professional mind by the independent fear of the more mysterious gamma and neutron radiations. Therefore, professional interest has been centered on the hazard of gamma and neutron radiation, immediate or delayed. The underwater atomic bomb burst at Bikini immediately followed by wide public discussion of the fearful death that might come from the poisoning of water by long-life radioactive particles seemed to strengthen the concept that those particular radiations were those to be avoided. Radiation hazards are not to be minimized, but the biologic potentialities of the thermal injury (burns) resulting from such explosions must be considered also, so that disaster plans will weigh in proper proportions how much of the total national medical effort should be applied to this aspect of the overall problem of preparation for atomic bomb attacks.

It is well to consider the nature and magnitude of the "burn problems" following the explosion of an atomic bomb (Hiroshima type) over an American city of 250,000 population. Observations at Hiroshima, coupled with other published data, suggest that the area immediately beneath the air burst (hypocenter) out to approximately 1,500 yards would sustain heavy damage from the combined effects of blast, gamma, and neutron radiation and would also be the zone subjected to the most intense thermal radiation.

[1] Reference: Medical News Letter, Vol. 16, No. 5.

In the outer zone from 1,500 to about 4,000 yards, attenuation of radiation flux is so great that injury primarily caused by radioactivity may not be an important problem, but radiant heat is still dissipated in such large amounts that severe burns result.

Hence, one must expect to find most of the surviving, seriously burned persons in the 1,500 to 4,000 yard zone. It is difficult to estimate from the Hiroshima experience how many burn casualties would result. It is the accepted opinion that although the figure would run into several thousands, the figure still would not be astronomically high. Former predictions may well be too high because they resulted from estimates which assume that an atomic bomb attack would be made on an unwarned population, outside of shelter and lightly clothed. Defense plans should provide this nation with an efficient border radar screen so that adequate and timely warning of most bomb attacks can be given. Complacency toward the burn problem cannot be tolerated, because if any large American city suffers atomic attack, the numbers of burn casualties will tax all preparations authorities are likely to be able to provide.

The flash burn from an atomic bomb explosion in general simply means thermal injury resulting from the absorption of a large amount of radiant energy (infrared, visible, ultraviolet) in a short period of time. The resulting burn is probably in most respects similar to the ordinary burn; it differs from it mainly in that this energy (same quantity in both instances) is imparted to skin in an exceedingly short period of time. These atomic flash burns likewise resemble ordinary burns as regards depth of skin destroyed. These burns may be superficial resembling sunburn (1st degree) or deeper (2d degree). Japanese observers reported that such burns were extremely painful, the same phenomenon noted in ordinary superficial burns.

If more radiant energy had been absorbed, deep burns resulted, with subsequent full thickness skin loss. These deep burns resembled ordinary third-degree burns: They were painless and healed only if small; if large they healed only after skin grafting.

Secondary burns produced by flame damage from spontaneous ignition of clothing or direct contact with flames in escaping from burning

buildings were common in Hiroshima experience. Burns with associated injury should be expected in any atomic bomb attack. The associated injury is related to the blast effect of the bomb with multiple lacerations and glass wounds from flying debris and ordinary skeletal trauma (fractures, simple and compound). From a surgical point of view, the seriousness of this associated injury is twofold:

1. Such additional trauma increases the severity and incidence of shock because of accompanying blood loss; and
2. There is likelihood of increased serious infection because it may prove impossible to perform definitive surgery, early or late.

In the emergency management of the burn casualty, five details are highly important. These are:

1. Relief from pain.
2. Emergency dressing.
3. Prevention and treatment of burn shock.
4. Salt and water requirements to insure adequate urinary output.
5. The most feasible antibiotic therapy to aid in the prevention of infection.

It is apparent that in any calculation, conservative or otherwise, the requirements for adequate reserves of plasma and/or whole blood would be in such large amounts as to make it almost out of the question ever to expect such a supply to be available in any stricken city. **It is imperative that search for a safe, effective, easily stored plasma substitute be instituted.**

FIRST-AID TREATMENT OF CASUALTIES FROM ATOMIC BOMBING [2]

In conjunction with a discussion of first-aid measures in an atomic bombing attack, figures estimating the number and types of casualties to be expected are presented. Based on Hiroshima and Nagasaki experience, it is estimated that with an atomic bomb of the Japanese type 100,000 casualties more or less may be expected. Of these: About 20,000 will be killed outright; 40,000 will be immediate hospital cases; and 20,000 will be ambulatory casualties. Another 20,000 will not report immediately. Approximately 50,000 people can be expected ultimately to die. It is possible that good medical management could save the lives of 10,000.

Newer types of atomic bombs may well produce larger numbers of casualties, perhaps 50 or 60 percent more. Smaller atomic weapons, guided missiles, shells, and so forth, may be used and would give fewer casualties according to their size. After a bombing attack the function of the doctor would be twofold: To render first aid and to engage in casualty sorting or in the recognition and the separation of the more seriously injured for purposes of priority in definitive care. Whether he would do so independently or as a member of a trained civilian-defense team would depend on his particular situation and the extent to which such teams had been organized prior to the attack. This outline of first-aid treatment is designed to serve until civilian-defense organization has progressed to the point where more detailed procedural instructions can be drawn up to replace it. When that time comes supplies of burn dressings, litters, decontamination kits, and record tags for emergency care will also be made available.

High-explosive bombs of the type used in World War II caused three types of injuries—blast, physical trauma from falls or from falling debris, and burns. In the bombings of Japan the blast effect, though very great and undoubtedly the cause of many deaths, was rarely seen among survivors. Atomic bombs have substituted radiation injury and radioactive contamination for blast. Thus, first aid in case of atomic attack must be chiefly given for physical trauma, burns and radiation injury, and radioactive contamination.

Physical trauma.—Trauma due to falls or to falling or flying debris will probably always remain, regardless of the type of weapon used, in the forefront of causes of disability among survivors of a bombing attack. It was evident in 70 percent of the survivors of the bombings of Japan. Many of these injuries were contusions and lacerations and of no great importance. They should, however, be treated thoroughly early to avoid any possible complications during the period of later radiation sickness.

Burns.—Burns are a more common source of disability after atomic than after high-explosive bombing, and occurred in from 65 to 85 percent of the casualties at Hiroshima and Nagasaki. They are of two types, flash and flame. The flash burn is more superficial than the flame burn, but presents more severe destruction of involved tissue.

[2] Reference: Medical News Letter, Vol. 16, No. 11.

It is due to the tremendous radiated heat of the bomb and is incurred by those exposed up to 2½ miles from the hypocenter. It is usually readily recognizable because it involves only one side of the patient. Thus, it cannot involve more than 50 percent of the body surface. The flame burn, due to burning buildings or clothing kindled by the heat, is more penetrating but less severely destructive of involved tissue. Flame burns occurred in 5 percent of the Japanese burn cases. First-aid treatment for both flash burns and flame burns is the same.

Loose and torn clothing and large, easily detachable debris should first be removed from the injured skin, but no vigorous efforts to clean the burned area should be made. A sterile occlusive dressing should be applied with light pressure at an early opportunity. There will be an individual decision here whether the dressing should be applied as a first-aid measure or an hour or two later in a dressing station or hospital facility. It is probable that the availability of such facilities and of the transportation thereto will be of such a low order that it will be more desirable to bring the dressing to the patient than the patient to the dressing. Mobile burn units will undoubtedly be organized to care for this. At present it is recommended that the dressing be undertaken as soon as the doctor can obtain adequate materials, assistants, and leisure time. It must be remembered that the dressing should be a good one, since the avoidance of infection in these patients, all of whom will have had some exposure to radiation, is of paramount importance. Under ideal circumstances the first dressing should not be changed for several days.

The dressing should have as its base a petrolatum or anhydrous lanolin ointment applied on a fine-meshed gauze as an inner layer. Dry gauze and materials that will adhere to the wound, such as absorbent cotton, should be forbidden. Irritating and colored applications and agents forming eschars, such as tannic acid and gentian violet, are to be avoided. Cotton or machinist's waste makes an excellent outer layer of padding to the dressing. This should be wrapped on with roller gauze or elastic bandage at an even, gentle pressure.

The flash burns are exceptionally painful, but the pain is usually relieved by application of the dressing. If this is not effective, a small dose (maximum of 10 mg. and less in the aged) of morphine may be given.

Burn shock.—The treatment of burn shock is not strictly in the province of first aid. Recognition of it for purposes of priority in evacuation is important. It is roughly predictable on the basis of the amount of body area burned. Anyone receiving a burn of more than 20 percent of the body surface should be tagged for treatment of impending burn shock and treated initially by strict rest, which is also important in the treatment of radiation injury.

Pharyngeal burns.—The detection of nasopharyngeal burns by examination for burns of the nasal hairs and hoarseness is of great importance in determination of priority for observation with a possibility of tracheotomy in mind. Such patients are safer and more comfortable in a semirecumbent position, not lying flat.

Radiation injury and radioactive contamination.—Radiation injury was present in over 30 percent of the Japanese casualties. There are two sources: Immediate direct radiation injury produced by gamma rays from the burst itself, and delayed injury from the effect of contact with radioactive residues of the bomb which fall from the bomb cloud or are spread to the area in dust or water. This second source may also include radioactivity induced in inert substances by neutrons.

The early treatment of radiation cases consists only of recognition of the possibility of radiation sickness from the history of adequate exposure (the limit of serious radiation injury in Japan was about 1 mile from the ground center); provision of complete rest for people dangerously exposed; provision of serial white-cell counts and hemoglobin determinations as measures of severity of exposure; institution of oral antibiotic therapy, preferably with aureomycin, to limit bowel ulceration and hemorrhage during the impending period of leukopenia (rutin may also be advised); and adequate observations for intercurrent disease, especially infections, in the early stages.

Of these principles, rest is the only one that can be strictly considered to be in the province of first aid. First aid may well be regarded, however, as including the process of dealing with contamination from radioactive residues. This covers recognition of contamination, early decontamination of

those affected, and avoidance of contamination of those not affected.

Recognition of contamination.—Monitoring devices will be necessary to establish with finality the presence and degree of contamination. (See Medical News Letter, Vol. 16, No. 5, p. 2.) A rough prediction can be made from the height of the explosion. That which is most efficient for the destruction of property is from 1,500 to 2,000 feet above the ground. At this height fission products are carried away in the tremendous updrafts forming the mushroom cloud, the extent of ground contamination is negligible, and protective measures will probably not be necessary. If a bomb explodes close to or under the ground or the surface of the water, large amounts of radioactive materials may be distributed for distances of greater than 2 miles. Under such conditions it will be essential to set up zones according to density of radioactivity. Traffic into the most dangerous zones will be eliminated except for essential trained personnel.

Decontamination.—People in a radioactive zone should, on evacuation from the zone, remove clothing and wash themselves thoroughly, preferably with a detergent. Such decontamination obviously can be partially undertaken within the zone, provided proved noncontaminated materials and clothing are available for the purpose.

Avoidance of contamination.—External contamination of the body surface is not difficult to avoid when one enters a contaminated area. A "no touch" technique should be used. To facilitate this, disposable footwear and gloves should be provided. **Internal contamination** of the body from inhalation or ingestion of fission products is more dangerous. Contaminated food and water supplies, with some exceptions, will only be available for consumption after radioactive survey. Generally speaking, food in intact containers will be safe so long as contamination is not introduced when the container is opened. If mist or dust is present in the contaminated zone people should wear a wet handkerchief or preferably a gas mask.

Casualty Sorting.—Since the number of casualties following one atomic explosion is so great, the populace as a whole will obviously undertake responsibility for active service in the disaster. First-aid and rescue training must be nearly universal. The following general principles for casualty sorting are set down as suggestions.

One should first attempt to get an over-all picture of the numbers of casualties and the possible aid available in the area. A few minutes occupied in an initial survey of the situation and the enlisting and organization of available help will often be of more value than the too early concentration on protracted first-aid measures to one badly injured casualty.

One should next tag or otherwise make a record, which will be fastened to the clothing of each patient treated or evacuated. The diagnosis should be specified, lesions that lie beneath dressings described, suspicions of internal injuries recorded so that patients may be held for observation. The location of patient at time of explosion and the suspicion of radiation overdose should also be recorded.

Surgical casualties should be divided into categories with an eye to priority for definitive care. A convenient classification is one modified after Trueta, the highest priority being listed first:

1. *Those who need definitive treatment as soon as possible.*—The group includes patients with severe hemorrhage, open chest wounds, extensive destruction of soft tissues, avulsion of limbs, and penetrating abdominal wounds.

2. *Those who need immediate definitive treatment but may wait until the first group has been dealt with.*—The group includes patients with compound fractures, penetrating wounds of joints, wounds of the face, and burns of more than 20 percent of the body surface.

3. *Those who need immediate resuscitation and rest but no operation, at any rate during the first few hours.*—The group includes patients with severe shock, small penetrating wounds of the chest, and crush injuries.

4. *Those who after receiving first aid should be transferred to a center for special treatment.*—The group includes patients with major injuries to the head, peripheral nerves, and eyes.

5. *Those who may be sent home after some form of simple treatment.*—The group includes patients with contusions, lacerations, sprains, simple fractures of the nonweightbearing bones, mild cerebral concussion, and minor burns.

Nonhospital cases with potential radiation sickness must be followed carefully in order that antibiotics can be begun as soon as the diagnosis is established (New England J. Med., 2 November

1950, R. H. Warren and J. H. Jackson, Committee on Emergency Medical Service, Massachusetts Med. Society).

PERSONNEL DECONTAMINATION

Clothing.—The decontamination of personnel is a primary requirement. All personnel who may be contaminated should first remove clothing, bury it to prevent spread of the radioactivity into uncontaminated areas. Normally, clothing will prevent access of the radioactive material to the skin. **Do not** burn clothing unless a **specially designated place** has been **designed** for this special **purpose.** If at sea, contaminated clothing could be thrown overboard.

Shower.—Then have personnel take a good shower, using plenty of soap and water. Pay particular attention to hair, nails, skin folds, the areas surrounding body orifices, and using care not to cause abrasions. Synthetic detergents, soapless household cleansers, have been very effective in place of soap.

Chemical agents.—If soap and water does not produce the desired reduction in activity, chemical agents, if avilable, should be used. Saline solution, isotonic, or keratolytic agents, such as a mixture of barium sulfide and starch will aid in removing material which clings to the skin. A dilute solution of sodium bicarbonate is useful, especially on mucous membranes. The mouth and nasal passages may be irrigated with this solution if deemed necessary. The eyes could be irrigated with it.

Other materials.—If no water is available with which to wash, any clean, uncontaminated material could be used. Paper, straw, grass, leaves, or sand could be used. Apply to the skin rubbing vigorously, care being taken not to tear the skin, or rub loosened material into wounds, folds of skin, or body orifices. Take a bath with soap or a detergent and water as soon as possible.

Great care must be taken after decontamination, to don uncontaminated clothing and to keep from re-entering a contaminated area if possible. If it becomes necessary to re-enter due to duties or other urgent reasons, don protective disposable clothing, gloves, and mask. Have all skin surfaces protected.

It will be necessary to provide a place for decontamination of large groups of personnel. The following is outlined merely as a guide. Facilities available, personnel to be decontaminated, personnel available to aid in decontamination, type of detonation (bomb used, if surface, subsurface, or air explosion), and many other conditions peculiar to each locality must be taken into consideration.

Ideally, a long building divided into three sections should be provided. Contaminated personnel enter one end of the building, discard all clothing, enter the middle section where showers, soap, rough toweling, and monitors with counters are provided. After each person has taken a shower and washed thoroughly, and has been pronounced decontaminated by a monitor, he then walks through a container of running water and enters the clean, or decontaminated section where clean clothing is provided, and exits through that end, not to re-enter contaminated areas again. The clothing provided should be simple to issue and should fit fairly well. Pajamas and some type of cheap shoe could be supplied until suitable clothing can be obtained. Separate buildings should be provided for male and female personnel.

It will be necessary to establish guards, especially on the outside of the building to keep contaminated personnel from entering into the section which the decontaminated personnel are entering after they have been decontaminated. These guards must be provided with complete protective clothing. Further personnel, well protected, must be provided for that section of the building into which contaminated personnel are disrobing, to keep the line moving as rapidly as possible and to remove contaminated clothing and other articles back into the contaminated areas for disposal.

A similar decontamination station could be set up on board ship.

MATÉRIEL DECONTAMINATION

This problem presents many complex aspects. In general, given sufficient time, effort, and personnel, any inanimate object, buildings, equipment, and other objects of material, may be decontaminated, at least partially, provided that it does not consist largely of porous materials. The question as to whether or not decontamination is

worth while depends upon the following factors to a great extent:

1. The importance of the structure or equipment.
2. The feasibility in the circumstances.
3. The risk involved.

If there will be an over-all saving of life or material, a protection of health, and the time element is justifiable, then decontamination should be carried out. Another factor is the personnel involved. How to carry out the task of decontamination in a manner which will not expose personnel to excessive dosages of radiation? Generally an individual cannot be permitted to work in a heavily contaminated area except for short periods of time, sometimes only a few minutes a week. The magnitude of decontamination can be readily understood. It may be better to isolate the section, building, or equipment, and forget it. A working plan may have to be evolved on the spur of the moment after all factors have been given serious consideration.

The process of decontamination can be resolved into two stages:

1. Immediate emergency measures, to permit continued operation.
2. Final decontamination of a more thorough nature.

For the emergency decontamination of matériel, almost any measure used would be beneficial. Cleaning and scouring compounds, detergents, dry-cleaning solvents, gasoline, kerosene, etc., will aid in removing radioactive particles from surfaces, especially those that are not porous.

The safety of personnel used in decontamination work is of prime importance. Protective clothing should be worn, rubber boots, gloves, goggles, and mask should be worn, especially if contamination is heavy, or likely to be stirred up during the "mopping up" process.

At present, general principles only are apparent and it is almost impossible to make predictions concerning the efficiency of any particular decontamination procedure in any particular circumstance. It will be necessary to use a succession of methods until the desired reduction in radioactivity is reached.

Physical methods of surface removal are often difficult requiring the use of much labor and usually special equipment. Wet sand blasting is successful on vessels and large concrete areas. However, disposal of the large volume of water and sand which is contaminated then becomes a problem. However, the radioactive material has been diluted, which aids in the problem.

Soft abrasive materials such as sawdust have been recommended for delicate articles. Steel-wool, wire brushes, and various types of polishing machines can be used for surface decontamination in certain instances and under various conditions.

Steam under pressure, mixed with a detergent, is effective, but again there is the problem of disposal of the contaminated wastes.

Chemical means can be applied for surface decontamination. This usually results in the transfer of the active material to large volumes of liquid, again presenting the disposal problem. Mere wetting of the surface by the solution of the chemical agent is nearly as efficient as flooding, and the waste material can be confined and controlled, although highly active. The method to be used must be determined by the circumstances.

Chemical methods can be designated for specific types of surfaces. Alkalies have been found effective in removing layers of contaminated paint.

A combination of physical and chemical methods is the live steam used in conjunction with detergents as mentioned before.

The contact of a blow-torch flame with a painted surface for a fraction of a second reduces activity. This method should not be attempted unless adequate ventilation is provided and personnel well protected.

Adhesives of various kinds have proven useful for removal of dust and mechanically held contamination. A strippable adhesive coating is sprayed on the surface and then stripped off. Sprayed coatings which can penetrate crevices can be used on fairly rough surfaces; these can then be stripped off. Adhesive plasters have been found useful.

Citric acid, acidified with hydrochloric acid has been found satisfactory for surface decontamination.

The decontamination of matériel will of necessity be governed by many considerations. The

above is a brief outline of some acceptable methods of decontamination. The radiological control officer at naval activities, and the civil defense officials in civilian areas will have the responsibility of the formation of plans and procedures to be carried out in case of necessity.

INDIVIDUAL PROTECTION IN ATOMIC ATTACK

Action Before Atomic Explosion

1. If sufficient warning is received, get at least 10 miles from possible target areas.

2. If sufficient warning is not given for travel, take deep cover (basement, subway, or heavy concrete building). Stay away from windows. Place disposable cover over you (sheet, blanket, etc.).

3. Do not take cover in wood or frame building if other cover exists.

4. Wear light color clothing (white is best) when attack is expected. Clothing should be loose-fitting and cover all of body (collar buttoned, sleeves rolled down). Leave least possible amount of skin exposed. (Women wear hose and long sleeves, light-colored slacks if possible.) The color of clothes worn at the instant of the explosion may be very important.

5. Do not look in the direction in which the bomb may be exploded regardless of distance from the target area.

Action After Atomic Explosion

1. If in the open at instant of explosion, take cover immediately whether or not you have been injured. Cover within 30 seconds may afford significant protection from certain aspects of an atomic explosion.

2. Put on some kind of mask or filter to prevent breathing of dust particles. Civil defense gas mask, dust respirator, doctor's gauze mask, or folded handkerchief over mouth and nose is essential. If improvised mask is used, it should be replaced with fresh gauze or handkerchief frequently. Do not go without mask while in target area.

3. If under disposable cover at instant of explosion, remain under cover for 30 minutes to 1 hour before disposing of the cover. This precaution need not be observed in the event of a high air burst.

4. If in deep shelter, remain in shelter until area is checked by Civil Defense Monitors unless forced to leave. Normally it will be wise to remain in shelter for 2 or 3 hours to allow initial radiation level to subside and to avoid possible panic. If forced to leave shelter early, use all possible haste in getting out of areas of heavy contamination; e. g., areas drenched with radioactive "rain," crater of bomb burst, center of damage.

5. If explosion was air burst (high, pinkish mushroom cloud), it is probably safe to remain in general area and aid in fire-fighting and rescue operations. Stay as far from center of damaged area as possible, however.

6. If explosion was surface or subsurface (low, dark cloud with "rain" of solid or liquid particles), get at least 10 miles away from target area as soon as you leave shelter. If required to assist in rescue work, don protective clothing.

Personal Decontamination

1. Upon arrival in safe area, remove all clothing (including shoes) and have them tested for radioactivity or destroy them as directed. Do not burn contaminated clothing. If monitoring team is available, check your person for radioactivity. Test all valuables in pockets or purses or bury them until test can be made. Do not continue to carry metallic items which were exposed to the explosion and do not pick up souvenirs from target area.

2. Take a thorough shower with strong or abrasive soap. Pay particular attention to hair, hands, fingernails, and feet. Use brush and scrub well. Repeat frequently for the first 2 or 3 days following exposure.

3. If there is any nausea or vomiting at any time, regardless of any apparent improvement shown or how "good" you may feel, get under competent medical care **at once.**

Chapter XIV

CHEMICAL WARFARE

Chemical agents may be used in warfare for various purposes: i. e., (1) to produce casualties amongst personnel; (2) to render areas, ashore and afloat, impassable or untenable; (3) to make matériel, food, or water unfit for use; (4) by setting up a chemical cloud of dense smoke, offer concealment for ships or installations; and (5) to start fires. So the scope of chemical warfare is broad.

The fact that chemical agents were used in the last war only to accomplish the two last named objectives should not give rise to a false sense of security. Chemical agents are always potential antipersonnel weapons as long as the possibility of war exists. It is a well-established dogma that adequate and successful defense against chemical warfare is only derived from protective measures (decontaminative and therapeutic procedures which have been well worked out in advance of an actual attack). When the details of these things have been anticipated, a number of results are achieved:

1. Fewer casualties.
2. Less disability.
3. Reduced panic and terror.

To appreciate this, one has only to study the experience of the unprepared Allied troops in World War I when gas was used on them. This aspect of the defense against chemical warfare, or of biologic and atomic warfare, cannot be underestimated.

A naval unit afloat finds itself in a unique situation insofar as chemical warfare is concerned. Due to the fact that these agents are usually released as clouds, or mists, they envelop the exterior of a vessel and penetrate within the hull due to the extensive use of artificial ventilation aboard ship. Thus, the contamination of the vessel may be extensive. In addition, the ship cannot be simply abandoned. It must be decontaminated at the same time as the personnel manning it must continue to eat, sleep, live, and fight on board.

The medical officer, or the hospital corpsman on independent duty, must organize the details of chemical warfare defense well in advance of actual need. This must include the indoctrination of all hands in the use of protective equipment and self-help. It includes close liaison and planning with the damage control personnel who are responsible for decontamination. It includes telling all medical personnel of the best methods currently available for the treatment of chemical casualties.

COMMON CHEMICALS OF WARFARE

Chemical warfare agents are classified in two different ways. The first classification concerns itself with the tactical employment of an agent; the second with the manner in which it exerts its damaging effect on the tissues of the body.

Tactical Classification

Duration of effectiveness—Persistent.—These agents maintain their effectiveness for periods of time between 10 minutes to hours, days, or weeks. Their primary use is to deny an enemy the use of an area of terrain. Mustard gas is the outstanding example of this type agent.

Nonpersistent.—These agents maintain their effectiveness for only short periods of time, less than 10 minutes. They are directed at harassing personnel, or as casualty producing agents. Their use will not deny the using force access and use of terrain. Phosgene is an example of this type of agent.

Tactical Use of the Agent

Casualty agents.—These injure personnel by making them casualties, in the same sense as wounding. Mustard and phosgene are examples.

Harassing agents.—These are usually quite irritating but not very toxic. They force personnel exposed to them to wear protective masks and equipment. Thus they hamper and impede mili-

tary operations. The irritant smokes are examples of this type of agent.

Screening agents.—These produce obscuring smoke which conceals the using force. They are usually nontoxic, or agents of relatively low toxicity. White phosphorus is an example.

Incendiaries.—These are used to set fires in matériel of an enemy. They can produce casualties by causing burns on the skin of exposed personnel. Their ability to cause casualties is, however, an incidental effect. Thermite is an example.

THE LUNG IRRITANTS

These agents produce casualties by causing massive lung edema. There are other agents which are highly irritating to tissue, such as mustard and chloropicrin, which are capable of producing an extensive amount of lung damage. The lung irritants proper, however, are not generally irritating to tissue. Their action is a highly specific one on the smaller divisions of the bronchial tree and the alveoli, or air cells, of the lung. Phosgene, for example, is nontoxic when introduced into the body by any means other than breathing.

Phosgene (CG) and Diphosgene (DP)

At the present time phosgene is the only lung irritant which is considered as a standard agent by the Chemical Corps. Diphosgene may be encountered, but, since it acts in the same manner as does phosgene, what is said about the one applies equally to the other.

Phosgene is a nonpersistent, casualty producing agent. It is a gas at ordinary temperatures and pressures and smells like ensilage, or fresh cut hay. The odor, however, is not pronounced or unpleasant enough to cause personnel exposed to it to become immediately aware of its presence in low, but effective, concentrations. It is a very toxic substance, as witnessed by the large number of casualties which resulted from its use in World War I.

Following the inhalation of phosgene, the patient may have a feeling of constriction in his chest, watering of his eyes, and a cough. More often, however, there will be no symptoms of poisoning until from 2 to 24 hours after inhalation, except for a transitory slowing of the pulse. Inasmuch as military personnel exposed to the gas during wartime will probably be engaged in manual effort under circumstances attended by more or less excitement, an increased pulse rate would be expected. Thus, if possibility of exposure exists and one finds individuals with pulse rates distinctly below normal, one may assume that these individuals have been gassed with phosgene.

At the end of the latent period, the individual begins to breathe in a rapid and labored manner and develops a cough which in most cases causes pain in the chest.

The lips, fingernail beds, ear lobes, and the conjunctiva of the eyes become bluish in color instead of the customary pink or red color usually found in these areas. This change in color is known as cyanosis. This stage of the clinical picture is known as the "blue stage." The individual then may become nauseated, and vomiting is not uncommon.

As the "wetness" of the lung becomes more extensive, the patient then becomes restless, apprehensive, and panicky because of the extreme difficulty of breathing. He raises copious quantities of frothy sputum, which may be more or less blood tinged. Then he may enter a shocklike state with cold, clammy, lead-colored skin; rapid, feeble pulse; and a very low blood pressure. This stage is called the "gray stage" and is usually followed by death.

Treatment of phosgene poisoning is symptomatic. Nothing is known, at present, which constitutes a specific remedy for it. Between the time of gassing and the appearance of symptoms, no treatment is indicated. During this stage the individual may be allowed to perform his ordinary amount of physical activity; he should, however, be spared extremely severe exercise.

Once symptoms have appeared, complete rest is mandatory.

Patients with lung edema should be kept only comfortably warm.

Oxygen is the keystone of the treatment and should be given whenever respirations become labored.

Other measures will be administered by the medical officer according to the requirements of any individual case.

Chlorine (CL)

Chlorine was the first toxic gas to be used in warfare. Its use as a weapon is improbable because of the advent of newer agents which have more suitable military characteristics. However, the exposure of naval personnel to chlorine vapors may occur under a variety of conditions. Chlorine, in contrast to phosgene, is very irritating to the respiratory tissues, but it produces edema as does phosgene. The wetness of the lungs appears, however, more rapidly, usually within twenty minutes following inhalation.

The primary irritation of the eyes can be relieved, if not too extensive, by washing out the eyes with rather copious amounts of water and then instilling an ophthalmic ointment which contains a local anesthetic such as butyn. If the irritation of the eyes is extensive, no treatment should be attempted until a medical officer can prescribe for it.

Pending the definite treatment by a medical officer, considerable relief will accompany the use of warm compresses to the eyes, using either distilled water or normal saline (0.85 percent NaCl).

The irritation of the respiratory tract can be relieved by the use of steam or benzoin inhalations. Since most fatal cases become so by a complicating bronchopneumonia, the use of prophylactic injections of penicillin (300,000 units daily) is indicated.

Nitrous Fumes

Nitrous fumes are generally mixtures of various oxides of nitrogen. They are not likely to be encountered as toxic war gases, but the possibility is frequently present for accidental exposures. These occur whenever smokeless powder, cordite, or plastic materials are burned in places where ventilation is inadequate. In addition, these oxides, or substances which produce them when burned, have come to play an important role in various fuel mixtures used in rockets, guided missiles, and jet engines. The latent period in the case of these fumes may be as long as 10 to 14 days.

The illness caused by inhaling toxic doses of nitrous fumes closely resembles that which follows the inhalation of phosgene; i. e., pulmonary edema. In addition, many cases will show mental symptoms, one of the nitrous fumes, nitrous oxide, being well known as "laughing gas." These symptoms may be disorientation, delirium, or mania.

THE VESICANTS

The vesicants, or blister gases, constitute the most important single group of chemical warfare agents. There are a number of these agents which may be employed, but the likelihood is that only mustard gas is of real importance. Other agents in this group are Lewisite and Nitrogen Mustard. While these latter two have been relegated to unimportant positions by chemical warfare authorities in the United States, they may be held in higher regard by others. These agents have their primary action on the skin and tissues of the respiratory tract where they cause chemical burns. In addition they are capable of causing serious systemic poisoning.

Mustard (H)

Mustard is an oily liquid which is slightly soluble in water, more soluble in fats and oils, and very soluble in gasoline, kerosene, acetone, carbon tetrachloride, and alcohol. It is slowly absorbed by rubber, and may in time penetrate to the interior surfaces of protective clothing and gloves. Thus these objects may in time become incapable of affording the protection they originally possessed. It has an odor which resembles that of garlic or freshly ground horseradish. Distilled mustard is odorless and colorless. Mustard is classed as a persistent agent.

The eyes are the most vulnerable part of the body to mustard. Contamination of the eyes by amounts not sufficient to cause injury elsewhere in the body will give rise to chemical inflammation of the eyes. Depending upon the concentration the injury may be anything from a simple conjunctivitis to a severe chemical burn which will destroy the eye.

Irrigate the eyes with water at the earliest possible time following exposure. If adequate washing with water can be accomplished within a few seconds, a great deal of damage can be prevented. However, if irrigation is not begun until 2 minutes or more have elapsed since contamination, then no amount of washing does any good. Washing of the eyes must be done before putting on a gas mask

regardless of the amount of mustard vapor present. The skin lesions can be treated much more successfully than can those in the eyes.

It should be realized that the standard protective ophthalmic ointment is only specifically protective against Lewisite and will only be of use against mustard by virtue of the ability of the fatty ointment base to dissolve some of the mustard.

The ointment is, itself, irritating to the eyes and must be used with caution. It would seem wise, therefore, to rely chiefly on prompt irrigation of the eyes with water to be followed by a thorough washing of the lids and face with soap and water as soon as practicable.

The **treatment** of conjunctivitis resulting from the action of mustard on the eyes is a matter for an ophthalmologist's special knowledge, but mild burns may be satisfactorily taken care of by less highly trained personnel.

Use bland ophthalmic ointments such as boric acid, or one containing local anesthetics. Saline compresses are useful. If the lids show a tendency to become glued together, this can usually be prevented by greasing the lids well with petrolatum or boric acid ointment.

No bandages or dressings should be applied because any pressure may cause destruction of the cornea.

Dark glasses are usually helpful in alleviating the increased sensitivity of the eyes to light.

The severity of the skin lesions depends upon the concentration of mustard applied, of course, but of more importance are the climatic conditions. Hot, humid weather will increase their severity; cold, dry weather will minimize them. It is important for hospital corpsmen to remember this, since an increase in the severity of burns will most certainly result from bundling patients in blankets and applying external heat to the skin with hot-water bottles.

Burns caused by vesicant chemicals are in no way different than burns caused by other modalities, such as steam or fire. The fluid in the blisters will not cause further blistering if the vesicle fluid comes in contact with unburned areas. One avoids rupturing these vesicles only in an attempt to prevent the infection of the burn. The general treatment for these burns is exactly the same as for other types of burns.

Any liquid material which remains on the skin should be promptly removed by blotting it off with absorbent material, such as paper towels, blotting paper, cotton, or soft cloths. It must not be rubbed off, since rubbing will only abrade the skin and worsen the exposure.

After the mustard has been removed, Protective Ointment (S-461 or S-330) should be applied and gently rubbed into the skin. Any excess should be removed. If the skin is reddened by the time the casualty is first seen, the skin should be simply cleansed with soap and water. The washing should be done with the hands only, and no brushes or washcloths should be used. The skin is then blotted dry with great gentleness.

In general the burns should be treated with bland, emollient, sterile ointments, over which sterile dressings are applied. Extensive burns will require evacuation of the casualty to a hospital, but most casualties will have minor to moderate burns which can be treated locally with the patient ambulatory on a restricted duty status.

A severely burned patient will sometimes present the picture of shock with a low blood pressure and rapid, feeble pulse. In such instances the use of morphine and plasma is indicated prior to evacuation. In any event all burns should be dressed with a bland sterile ointment and bandages before the patient is transported to the site of definitive hospitalization.

Nitrogen Mustard (HN)

The nitrogen mustards are oily, colorless, or pale yellow liquids. Their solubility is the same as that of mustard. The lesions produced by these agents are similar to those produced by mustard. They differ only in degree and in the period of time which elapses between the appearance of the lesions and exposure. First aid and the treatment of casualties is the same in all important generalities for both mustard and nitrogen mustard casualties.

Lewisite (L)

Lewisite is an oily, colorless, or light amber liquid that smells like geraniums. It is vaporized to a greater extent in cold weather than is mustard. For this reason it can be employed, and must be expected, in the event of war fought in cold temperatures or arctic conditions. Ground

contaminated with lewisite can remain capable of producing burns for quite long periods of time. The burns, eye lesions, and lesions in the respiratory tract are the same as those which result from exposure to mustard vapors. The skin burns are produced more rapidly and are more extensive than mustard burns. Lewisite, in contrast to mustard, produces pain in the exposed parts of the body within a short time following exposure. This is fortunate in that it calls attention to the fact of exposure and makes possible the early use of BAL ointment. This ointment is a specific antidote for lewisite.

Any liquid lewisite which remains on the skin should be removed by blotting it off with an absorbent paper or cotton. If BAL ointment is not available, soap and water will be the most effective means for the removal of the material. Kerosene, acetone, chloroform, carbon tetrachloride, and other petroleum solvents are effective only if used within a matter of seconds following exposure.

BAL ointment, when available, should be spread generously over the involved skin and then gently massaged in with the fingers. It should be allowed to remain on the skin for 5 minutes. The ointment, itself, is somewhat irritating, and so the excess should be washed off with soap and water if conditions permit. Severe burns should be treated in a hospital; minor ones can be handled as ambulatory cases.

THE TEAR GASES

These agents are not designed to produce casualties, but are used to harass enemy personnel with the idea of reducing their effectiveness by producing temporary disability and confusion. This is accomplished by producing a chemical inflammation of the eyes which results in a copious production of tears and stinging pain in the eyes. The vision of a person thus exposed to one of these agents is, for a period of time, practically nil. For the most part, tear-gas casualties will not require medical attention. The irritation produced is marked, but self-limited and brief. If pain persists in the eyes, some relief can be afforded by the sparing use of an ophthalmic ointment containing a local anesthetic. There are two standard tear gases on the list of chemical agents of the Chemical Corps. These are Chloracetophenone (CN) and Chloracetophenone-Chloroform Solution (CNC).

Sometimes gross contamination of the skin with liquid tear gas will produce chemical burns in a manner similar to those produced by the vesicants. The skin can be effectively decontaminated by the use of 4 percent sodium sulfite in alcohol. If this solution is not immediately available, ordinary "hypo," which is used as a fixing solution by photographers and radiographers, will constitute a substitute. The treatment of the burns caused by liquid tear gas which has not been successfully removed from the skin will ordinarily be mild and can be treated in the same manner as simple burns resulting from other causes.

THE VOMITING GASES

(Nose gases, irritant smokes, or sternutators)

These agents are all crystalline solids which are dispersed by burning them. The resultant smoke produces an irritation of the upper respiratory tract. The symptoms following inhalation do not appear for several minutes. This fact frequently causes a person to believe that his mask is faulty, so that by taking it off his exposure to the smoke is more severe. In practice a preliminary dispersal of an irritant smoke may be followed by the dispersal of a lethal gas, so that the removal of a gas mask may be extremely hazardous. It should be remembered by all personnel that the gas mask affords adequate protection against these agents.

Adamsite (diphenylaminechlorarsine) (DM)

Adamsite produces a chemical, local inflammation of the nose, sinuses, throat, and eyes. The casualty usually complains of pain and a sense of fullness or "stoppiness" of the nose. In addition, there are usually severe headache, burning in the throat, and chest pain. The eyes become bloodshot and tears are copious. The casualty suffers from violent, uncontrollable coughing and sneezing. Nausea and vomiting are prominent. This agent is characterized by producing severe mental depression, panic, and poor judgment. These mental symptoms may be so marked that the subject may have to be restrained from suicidal attempts. The symptoms, while very alarming, will

usually abate fairly quickly. Within one or at the most three hours they will have disappeared completely. During the height of the symptoms, chloroform inhalations just under the point of inducing anesthesia have been found helpful. Aspirin or APC tablets can be administered for the headache, but usually the medication will be vomited before absorption can take place.

There are two other irritant smokes which may be encountered; these are DA (diphenyl-chlorarsine) and DC (diphenylcyanarsine). These cause symptoms similar to those caused by Adamsite, and the poisoning runs the same brief course. Treatment is, therefore, the same in all cases.

THE BLOOD AND NERVE GASES

(Systemic poisons)

These agents are all casualty-producing agents and are potentially lethal. They represent several types of chemical compounds, and they poison in different ways. They all, however, destroy some vital enzyme system, without which life cannot be sustained for a very long period of time. In every instance of poisoning by these agents, treatment must be prompt and specific if it is to benefit a casualty.

Hydrocyanic Acid (AC)

Hydrocyanic acid is a colorless liquid which boils at room temperature. It has an odor resembling that of bitter almond oil and is extremely toxic. In high concentrations a few breaths may result in immediate death. It poisons by interfering with an enzyme system which is essential for the utilization of oxygen by the tissues. Exposure to lesser concentrations may result in death after a period of hours or several days.

The symptoms of cyanide poisoning vary with the severity of exposure. After exposure to high concentrations, there is a forceful increase in respiration for a few seconds, followed by a failure of respiration within about one minute. Before respiration ceases, the casualty manifests several violent convulsions. The action of the heart continues for a few minutes after respiration ceases and then it ceases beating.

Treatment must be prompt.

1. The inhalation of two amyl nitrite pearls for 20 to 30 seconds out of every 2 minutes is recommended as a first aid procedure.
2. Then, as soon as possible, 0.5 gm. of sodium nitrite, put up in 50 to 100 cc. of sterile distilled water, is given intravenously.
3. Following this injection, 25 gm. of sodium thiosulfate in 300 to 500 cc. of sterile distilled water are given intravenously.
4. It may be necessary to give 0.05 gm. of ephedrine sulfate by hypodermic injection in order to overcome a marked fall in blood pressure which frequently follows the injection of sodium nitrite.
5. Additional oxygen should be given by mask.
6. The casualty is then carefully observed for signs of failing respiration. If these appear, another series of sodium nitrite and sodium thiosulfate injections are given; only the amount of each is reduced to one-half of the original dose.

Mild exposures are accompanied by nausea and headache. These cases will recover spontaneously and usually require no treatment. However, they should be carefully watched for signs of respiratory failure or convulsions. If these occur the treatment outlined above is promptly instituted.

Cyanogen Chloride (CK)

Cyanogen chloride is a colorless liquid which vaporizes at 15° C., so that at ordinary temperatures personnel are exposed to its vapors. These vapors are quite irritating to the eyes, nose, throat and respiratory passages. Cyanogen chloride has a double toxic action due to the fact that it contains cyanide and also chlorine. The cyanide content is responsible for poisoning like that described for hydrocyanic acid and is treated in the same manner.

The chlorine causes inflammation of the eyes, nose, throat, and lungs. It produces edema of the lungs similar to that previously described under chlorine poisoning. The treatment of the lung edema is the same as in this latter poisoning.

The "G" Agents

These compounds are the newest agents of chemical warfare. They are all extremely toxic and effect their poisoning by destroying an enzyme which is essential for the balanced control of the nervous system. The effects are most prominently seen in the eyes, the lungs, and the intestinal tract,

but almost every nerve function is upset because of the lack of the essential enzyme. These compounds can be absorbed by the eyes, the intact skin, and the respiratory system. Both the vapors and the liquid are effective. The gas mask gives protection against vapors, but impermeable clothing is only partially successful in protecting the skin.

The first symptom of poisoning is a marked constriction of the pupils. Respiration becomes difficult and ineffective, due to the fact that the smaller divisions of the air passages become very small in caliber. Death is frequently the result of asphyxiation. The activity of the bowel is increased, causing diarrhea and vomiting. The muscles of the legs, arms, etc., may become paralyzed and manifest uncontrollable quivering. Convulsions and mental disturbances must be anticipated.

Treatment.—Many of the disturbances of body function can be controlled by giving atropine either intravenously or intramuscularly. Large doses are required; 2 milligrams is considered the minimum effective dose for these cases. Atropine must be given promptly on the field, either by the casualty himself or by a companion. It is anticipated that a proper dose of atropine in a form which can be readily given by untrained personnel will be a regular issue to all hands along with a gas mask.

If a casualty has ceased breathing or has marked depression of his respiratory activity, atropine should not be given until after he has had positive pressure artificial respiration with oxygen. Breathing should be effective and the color of the lips and skin relatively normal before atropine is given. If it is given in the presence of a state of partial suffocation, it will cause a disordered action of the heart which will always be fatal.

In general, prone pressure or other conventional types of artificial respiration will fail to improve the efficiency of breathing due to the paralysis of the muscles. Not enough exchange of air can be effected by those methods. An apparatus which can deliver oxygen under positive pressure will be required.

Measures to combat convulsions and other symptoms must be taken by a medical officer, since precise judgment in the use of medications is required.

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THE SCREENING SMOKES

These agents are not directed either to harass personnel or to produce casualties. They are used to provide concealment. They are not toxic in the usual concentrations which accompany their use under field conditions, but they give rise to toxic symptoms if they are encountered in close spaces where accidental discharge has occurred.

White Phosphorus (WP)

This agent burns vigorously when exposed to air. It can produce very deep, painful burns if it comes into contact with the skin. Burned areas should be immediately covered with water, urine, or other nonirritant watery solution. The submersion of the burned part should be maintained until such time as a 5-percent solution of copper sulfate can be applied. Oily or fatty ointments should not be used, since phosphorus is soluble in such preparations and, when dissolved, is absorbed by the body, thus giving rise to phosphorus poisoning. The burned areas should be kept covered with dressings soaked with the copper sulfate solution until they can be treated by a medical officer.

Titanium Tetrachloride (FM)

If the liquid comes in contact with the skin, it will cause the same sort of burns generated by burning FM in high concentrations and will prove quite irritating to the eyes, causing them to become bloodshot with a copious production of tears.

The best treatment is to wash either the eyes or skin with copious amounts of water. Burns are treated after washing just as are burns due to other causes.

Sulfur Trioxide—Chlorsulfonic Acid Solution (FS)

Here again, the liquid will produce an acid burn. Exposure to the smoke may give an irritating prickly sensation to the skin. FS can seriously damage the eyes if it is encountered in high concentrations.

The first-aid treatment of eye burns due to FS is:

1. Prompt irrigation with water.
2. If there is pain, anesthetic eye drops or Butyn ophthalmic ointment may be instilled.

3. The eyes are then covered with a light sterile dressing applied in such a manner as not to exert pressure on the eyeballs.

4. The casualty should then be gotten into the hands of an eye specialist, who can undertake appropriate treatment for any ulceration of the cornea which may have taken place.

HC Mixture (HC)

This smoke is nontoxic in the usually encountered field concentrations, but fatalities have occurred when high concentrations have been encountered in enclosed spaces. These cases have, in almost every case, resulted from the use of HC smoke to add realism to fire drills. This practice is dangerous. HC smoke, when inhaled in high concentrations, causes damage to the lung tissues, with the result that massive lung edema or chemical pneumonia may develop and prove fatal. The treatment of these complications follows the same lines as for chlorine or phosgene poisoning.

OTHER NOXIOUS GASES

In addition to the chemical agents which have been presented, there are several other noxious gases which may be encountered aboard ship under various circumstances. These gases are gasoline fumes, carbon monoxide, carbon dioxide, and carbon disulfide.

Gasoline Fumes

There have been numerous instances of intoxication due to the inhalation of high octane gasoline fumes aboard tankers and aircraft carriers. There are two effects, one due to the highly volatile gasoline itself and the other due to the tetraethyl lead in the mixture. The first is the more important because it is the most frequent cause of gasoline intoxication. The hazard of tetraethyl lead is not great when vapors are inhaled, but it becomes more of a hazard when extensive liquid contamination of the skin has occurred. The fumes of gasoline produce effects on the brain similar to those which result from the ingestion of alcohol or breathing ether fumes. The first effect is to produce what is known as euphoria or a false sense of security and well being. This stage is similar to a "happy jag" due to alcohol. The thinking ability of the individual is faulty, and his gait becomes unsteady. This frequently results in bodily injury due to falling against metal objects. In at least one case, fatal burns resulted from lighting cigarettes when in this state of the intoxication. Later stages result in unconsciousness and a depression of respiration. Death is usually the result of suffocation.

Treatment of the first stage:

1. Remove the casualty to a well ventilated space.

2. If the casualty is boisterous and unmanageable the use of paraldehyde will give proper sedation.

3. The use of morphine or one of the barbiturate drugs is usually unwise. They should not be given unless ordered by a medical officer. The effects will wear off after a period of time spent in fresh air, the length of which depends upon the severity of the intoxication.

Treatment of the later stages:

1. Artificial respiration.
2. Inhalation of oxygen.
3. Injection of coramine intravenously or by hypodermic.
4. It should be remembered that as a casualty recovers from severe intoxication he will pass through the lesser stages and will require restraint and close supervision if injury or self-destruction is to be prevented.

Carbon Monoxide

This gas is produced whenever petroleum products are burned or when animal products are either burned or become decomposed through putrefaction. The gas combines with the hemoglobin of the blood to form a permanent, new, chemical compound which is called carboxyhemoglobin. This compound does not pick up and deliver oxygen the way normal hemoglobin does. This results in an oxygen deficiency which is frequently severe enough to cause fatal suffocation. It is an odorless, colorless gas which is an insidious poison. It may cause headache before unconsciousness comes, but in most instances the individual becomes first drowsy and then unconscious. It should be remembered that the effects are aggravated by muscular effort, which increases the body's need for oxygen. Carbon monoxide is to be anticipated in every fire and in ships holds where food or bodies have been decaying.

The recognition of carbon monoxide poisoning is assisted by the fact that the presence of carboxyhemoglobin in the blood gives the skin, lips, and conjunctivae of the eyes a bright, cherry-red color. This color, plus the circumstances of exposure, usually makes a diagnosis fairly easy.

Treatment

1. Remove the casualty to a well ventilated space.
2. Oxygen or oxygen-carbon dioxide mixtures are then given as long as any heart action lasts.
3. The use of whole blood transfusions is very useful, but plasma is without value.
4. A severely poisoned person should be hospitalized as soon as his condition permits. One decides this by observing his color and the character of his respiration.
5. It is usually unsafe to evacuate these patients by air due to the deficiency of oxygen which always accompanies altitude.

The reason for hospitalization is to place the casualty in the proper hands for the treatment of after effects which frequently follow carbon monoxide poisoning.

Carbon Dioxide

This gas may be expected in any closed space where fire or decaying animal or vegetable products have been stowed. The poisoning results not from any toxicity of the compound but from the fact that where it exists in high concentration, there is insufficient oxygen present to sustain life. The effects, then, are those of suffocation due to inadequate oxygen in the air. Unconsciousness is produced sometimes very quickly after entering such an atmosphere. A gas mask is not able to protect a person from inadequate oxygen. Rescue parties or other persons required to enter high concentrations of carbon dioxide must wear equipment which provides oxygen, such as the Rescue Breathing Apparatus.

Treatment

1. Removal to a ventilated place.
2. Artificial respiration.
3. Oxygen inhalations.

There are usually no after effects.

Hydrogen Sulfide

This gas is colorless and smells like rotten eggs. Unfortunately, however, in high, and therefore toxic concentrations it paralyzes the sense of smell. Thus its odor is not to be counted on as a detective measure. The gas is a systemic poison of the same degree as hydrocyanic acid. It kills by paralyzing the respiratory center of the brain. In those exposures which are not lethal, massive edema of the lungs, which is similar to that following the inhalation of phosgene, is produced. Hydrogen sulfide is encountered in places where sulfur containing animal tissue has been decaying or burned; thus, it is found in sewers, waste coal bins, stack gases, and ship compartments where rotting food or bodies have been located.

The prominent symptom is irritation of the eyes, nose, and throat, with the production of abundant tears and secretions. The casualty's breathing becomes at first deep, noisy, and gasping, but later it is feeble and irregular. A complete cessation of breathing within a few minutes after exposure to high concentrations is common.

Treatment

1. The prompt removal of the casualty to a well-ventilated place.
2. Artificial respiration should be administered as long as any signs of heart action can be detected.
3. Oxygen should be given along with the artificial respiration.
4. Occasionally coramine (5.0 cc. intravenously) will be helpful in overcoming respiratory paralysis.
5. It may be given as often as needed to keep respiration going.

Casualties who recover from the immediate effects must be observed for as long as ten days before it can be assumed that pulmonary edema will not develop.

Ammonia

Ammonia may be encountered when accidents occur in or around refrigeration plants. The gas can be readily recognized by the biting, markedly irritating, characteristic smell. The gas is so irritating that personnel cannot stay in an atmosphere containing as much as 0.1 percent of ammonia. The irritation causes cough and spasm of the

upper air passages. Later effects are the production of a bronchitis or massive edema of the lungs.

Treatment

1. Removal of the casualty to a ventilated space.
2. The inhalation of vinegar fumes or dilute acetic acid fumes is sometimes helpful.
3. Oxygen inhalations.

A period of ten days may elapse before the danger of pulmonary edema has passed, so that casualties must be observed for at least that period of time. Pulmonary edema, if it develops, is treated as previously described under phosgene poisoning.

THE FIRST-AID TREATMENT OF GAS CASUALTIES

The service gas mask is the most important protection against chemical agents. This equipment protects the two most vulnerable parts of the body—the eyes and the lungs. The present canister will give adequate protection against all known war gases and against most industrial exposures, with the important exceptions of carbon dioxide and carbon monoxide. Hence, if the exposed person has not already donned his mask, he should do so at once; or if he is unable, someone should put it on for him. Prior to donning the mask, however, he should decontaminate his eyes by washing them out with water. Any liquid agent which is on the skin covered by the mask should be quickly blotted off with a cloth or absorbent paper. All of these things should be foregone in the interest of preventing further lung exposure in regions where the concentration of an agent is high. Skin and eye damage can be treated more effectively than can damage to the lungs.

It is not likely that protective clothing will have been put on prior to an attack; therefore clothing and equipment will be contaminated. As soon as possible all contaminated clothing should be removed and handled in a manner to be described later. The skin contamination then can be reduced by blotting off the material with some absorbent material which is then discarded. Protective ointment can afterward be employed to remove the balance. The skin can then be gently washed with soap and water.

Casualties should not be wrapped in a blanket or have external heat applied until all liquid contamination has been removed. Even then they should be no more than comfortably warm and protected from chilling. The absorption through the skin of vesicant agents and probably those blood and nerve poisons which can penetrate the intact skin is enhanced by warming the skin.

Artificial respiration may be lifesaving in many cases. The various techniques for administering artificial respiration should be well known to all Hospital Corps personnel The use of oxygen in cases where there has been an exposure of the lungs is, in most cases, routine. Where any doubt exists, it should be administered, since it has little likelihood of being harmful and since failure to give it may be quite serious.

Much of the damage done by chemical agents will be psychological. Corpsmen and other medical personnel will be able to do much to minimize panic, anxiety, and fear by reassuring exposed personnel, by remaining calm themselves, and by the efficient, orderly performance of countermeasures. The effect on others of a trained person calmly going about his duties in the face of a panic-provoking situation should not be underestimated.

Most of the effective first-aid measures are best undertaken before exposure has occurred. These measures are all lumped under the head of gas defense discipline. Training which will enable a man to quickly get his mask on, clear it, and get it properly adjusted; the confidence one gets in knowing that a properly worn mask will give protection; and the knowledge that medical personnel are available to effectively treat casualties tend to minimize panic. If panic and fear can be effectively minimized, then the results of any gas attack are reduced considerably.

Therefore, it is obvious that all hands should become thoroughly familiar with the gas mask and its care. They should come to regard it as an important personal possession which, if kept in first-class condition, is capable of saving their lives.

Decontamination

In order to quickly handle casualties a carefully worked out procedure must be ready for use. The agents which are troublesome are the persistent one—mustard or one of the other vesicants.

The nonpersistent agents are largely self-decontaminating.

The responsibility for decontaminating the ship as a whole belongs properly to the damage control organization of the vessel. The medical personnel aboard should confine their efforts to the decontamination of personnel and to the treatment of casualties.

The guiding principle in personnel decontamination is to avoid the spread of contamination. If a ship is the target of a successful chemical attack, it must be assumed that all personnel are contaminated until proven otherwise. One should anticipate considerable difficulty during the early moments after an attack because a great many personnel will think they have been "gassed" and will, therefore, be frightened. It will require self-assurance on the part of medical personnel to successfully allay the fear almost certain to be widespread on a ship which has been attacked by chemical weapons. Here again, if all hands realize in advance of an attack that most exposures to chemical agents will result in no more than a temporary period of discomfort and are likely not to be dangerous to life, a great deal of fear and panic can be avoided.

Personnel should be divided into two main groups by a responsible person of the gas-defense organization.

The first group is the noncasualties. These personnel have been exposed to and may be contaminated with an agent but are physically able to carry out self-aid. These personnel should not be permitted access to spaces where the second group is to be treated.

The second group comprises the casualties; that is, those who cannot, because of physical disability, administer self-aid.

Aid Stations

Aid stations shall be topside or in some well-ventilated space. The location should be clearly posted for ready identification and marked off into clean and unclean areas. The clean area should be equipped with tightly covered GI cans or similar receptacles into which contaminated clothing is to be placed. Stocks of protective ointment and BAL ointment, plus an abundant supply of soap and water, should be made available. In addition, standard items of first-aid gear should be on hand. It is helpful if small trestles, boxes, or similar supports are improvised so that stretchers can be placed between them, and thus be raised off the deck. There should be several boxes containing bleach powder at the boundary between the clean and unclean areas of the aid station. Personnel are required to step into the boxes when passing from one area to the other. Casualties are decontaminated and receive first aid in the contaminated area. After these things have been accomplished, the casualty is removed to the clean area.

In the clean area additional treatment is given, pending removal to the place where specific and definitive treatment is to be given.

Management and Transport

Medical personnel must take all reasonable precautions to protect themselves while handling casualties. These precautions consist of wearing the service gas mask, using protective ointment, protective clothing, and the impervious apron which has been developed for wear by medical personnel handling contaminated cases. With the exception of the gas mask, supplies of these items are found in the gas casualty treatment case, unit No. 10, Supply Catalog Item 14–055.

Personnel handling contaminated cases must avoid spreading contamination to other personnel and to spaces not set aside as areas for the reception of contaminated cases.

Contaminated personnel, clothing, or equipment must be prevented from gaining access to uncontaminated areas which are totally enclosed. The subsequent decontamination of such spaces is quite difficult and must be avoided if at all possible.

Contaminated clothing and gear must be placed in specially designated dump areas and insofar as practicable kept in metal cans which are equipped with tight fitting covers.

SUMMARY OF SYMPTOMS AND FIRST AID TREATMENT OF CASUALTIES CAUSED BY EXPOSURE TO CHEMICAL WARFARE AGENTS

Type and name of agent	Symptoms in order of severity	Pertinent information and first-aid treatment
LUNG IRRITANTS		
Phosgene (CG)	Irritation, nose and throat; watering eyes; coughing; difficult breathing; pains in chest; lips, ear lobes, conjunctiva bluish color; strangulation; grayish palor of face.	Nonirritating except in high concentrations. May act immediately, symptoms often delayed 2 to 24 hours. Remove from gas atmosphere; loosen clothing; keep lying down; comfortably warm with blankets; nonalcoholic stimulants, tea or coffee; administration of oxygen frequently required. Evacuate soon as possible.
Diphosgene (DP)	do	Do.
Chlorine	Intense irritation of nasal passages; throat, chest, violent coughing.	Acts immediately. Treatment same as phosgene.
VESICANTS		
Mustard (H)	Eye effects: Irritation, inflammation of lids and cornea; blindness, usually temporary, rarely permanent, depending on concentration of agent.	Eyes: Irritated by concentrations not sufficient to cause injury elsewhere. Acts immediately in eye, especially liquid. Apply protective ointment. Prompt action essential. Ointment causes stinging pain but must be used. Irrigate with water one minute after using ointment.
	Skin effects: Redness or rash; intense itching; blisters; ulcer granulation and sloughing of tissues.	Skin burns: Symptoms delayed 2 to 6 hours in vapor form; 15 minutes to 1 hour liquid form. Vapor, remove from contaminated area, soap-and-water bath. Apply protective ointment. Liquid: Blot off skin, do not rub, remove contaminated clothes. Cut contaminated hair. Apply protective ointment. Blisters treated as any thermal burn. If vapors have been breathed, treat and handle as for lung irritant casualty.
Nitrogen mustard (HN)	do	Symptoms same as mustard but may be more rapid. Irritates the eye in extremely small amounts; treat as for mustard.
Lewisite (L)	Most symptoms same as mustard. Sneezing may be caused at once. Liquid burns first appear as grayish splotches. Burns usually not painful at first. There may be secondary symptoms of arsenic poisoning.	Eyes: Liquid in eyes causes severe pain. Force in Bal ointment, massage gently to spread. Prompt action required. Skin: Blot off, do not rub. Apply Bal ointment. Let remain few minutes, wipe off. Apply fresh ointment, spread over area and let remain. Speed is important. Get to hospital at once. If vapors have been breathed, treat as for lung irritants, but get to hospital. Intravenous treatment for arsenic poisoning will be necessary. Should be given by medical officer only.
LACRIMATORS (Tear gas)		
Chloracetophenone (CN)	Irritation of eyes; copious flow of tears. Blindness (temporary). Burning sensation on skin. Liquid on skin may produce blisters similar to vesicants.	Acts immediately. Remove from gas atmosphere; face wind, do not rub eyes. Wash with sodium bicarbonate solution or boric acid solution. Symptoms disappear shortly. Liquid burns: Wash with 4 percent sodium sulfite solution. Treat as any thermal burn.
Chloracetophenone-chloroform solution (CNC).	do	Treatment same as for chloracetophenone.
IRRITANT SMOKES OR STERNUTATORS (Vomiting gases)		
Adamsite (DM) (diphenylaminechlorarsine).	Irritation nose and throat; watery discharge from nose; coughing; pain at base of nose; severe headache; nausea-vomiting; mental and physical depression.	Irritation effects immediately. Other effects may be delayed 30 minutes or longer. Remove from gas atmosphere, place at rest; loosen clothing; bathe nose and throat with salt water or sodium bicarbonate solution. Keep away from heat. If mental symptoms become so marked chloroform inhalations just under point of anesthesia may be given.
Di-phenyl-chlorarsine (DA)	do	Do.
Diphenylcyanarsine (DC)	do	Do.

SUMMARY OF SYMPTOMS AND FIRST AID TREATMENT OF CASUALTIES CAUSED BY EXPOSURE TO CHEMICAL WARFARE AGENTS—Continued

Type and name of agent	Symptoms in order of severity	Pertinent information and first-aid treatment
SYSTEMIC POISONS		
Hydrocyanic acid (AC)	Headache; nausea; coma; convulsions; respiratory failure.	Action is immediate. Forceful increase in respiration first few seconds then respiratory failure. Remove to fresh air; artificial respiration; oxygen by resuscitator if possible. Inhalations of amyl nitrite pearls for 20 to 30 seconds each for 2 minutes. Not more than 8 pearls. Evacuate to hospital as soon as possible.
Cyanogen chloride (CK)	May be same as both lung irritant and hydrocyanic. Low concentrations produce lacrimation. Intense irritation of nose, throat; coughing, tightness in chest.	Has a double toxic action. Treat as for hydrocyanic acid first. Then treat as for lung irritant.
G-AGENTS (Nerve gases)	Constriction of pupil; respirations difficult; possible diarrhea and vomiting; muscular tremors; convulsions; massive salivation; unconsciousness.	Readily absorbed through any body surface; skin, eyes, respiratory tract, etc.; liquids more dangerous than vapors if on skin or clothing. Remove from area. Scrub skin with plain water if soap not available. Artificial respiration. Liquid in eye, wash thoroughly with water before donning mask. Prompt action is essential. If difficulty in breathing, atropine tartrate, 2 mg. injection, if no relief repeat in 5 to 10 minutes. No more than 3 doses atropine should be given. Use ampin or atropine syrette whichever available. Use resuscitator if available. Get to hospital at once.
SCREENING SMOKES		
White phosphorus (WP)	Usually not toxic for short periods, long exposure in high concentrations may cause temporary illness, depending on agent.	White phosphorus burns vigorously when exposed to air. May throw burning particles some distance. Deep painful burns in contact with skin. Remove clothing. Cover immediately with water, wet cloth or even mud. 5-percent copper sulfate dressing until removal of particles from skin. Then treat as any thermal burn. Immediate burns if in direct contact with liquid. Wash off with water, irrigate eyes with water or saline solution. Wash skin burns with sodium bicarbonate solution, then treat as thermal burn.
Titanium tetrachloride (FM).	Spray droplets or liquid produce acid burns in eyes or on skin.	Immediate burns if in direct contact with liquid. Wash off with water, irrigate eyes with water or saline solution. Wash skin burns with sodium bicarbonate solution, then treat as thermal burn.
Sulfur trioxide-chlorosulfonic acid solution (FS.)	Same as white phosphorus	Same as white phosphorus.
HC mixture (HC)	The most dangerous of screening smokes. High concentrations, a sense of suffocation; irritation of nose and throat; coughing; choking.	Light exposures, treat as for phosgene. Heavy exposures may require injections Bal in oil. Get to hospital at once if chest symptoms develop.

Chapter XV

BIOLOGICAL WARFARE DEFENSE

Definitions

Biological warfare.—The deliberate use of living organisms or their poisonous products to produce death, injury, or disease in susceptible man, animals, or plants.

Biological agent.—A living organism or its poisonous product capable of producing death or disease in susceptible man, animals, or plants.

Background

Epidemic diseases arising from natural causes have plagued military forces and civilian populations for centuries and have exacted heavy tolls in nonbattle casualties. Recognition of the seriousness of this drain upon military manpower undoubtedly led to crude attempts at waging biological warfare in the past through the deliberate pollution of water supplies used by the enemy. From time to time there have been other unsubstantiated claims of the limited use of biological agents.

But actually the dissemination of disease-producing organisms has never been employed on a significant scale and biological warfare is as yet an untried weapon. The employment of biological agents by an enemy must be accepted as a possibility. The production of epidemics by this means, however, appears unlikely because of the similarity of biological warfare results to diseases resulting from natural causes, and the fact that these past disease outbreaks have been well controlled by preventive medicine programs, public health procedures, and health sanitation practices.

Biological vs. Chemical Warfare

Biological warfare has certain aspects in common with chemical warfare in that biological agents may be dispersed in the air and travel downwind in the same manner as a nonpersistent gas cloud. They may be inhaled unless a gas mask is worn and may cause disability or death. They are capable of contaminating clothing, equipment, food, and water supplies. They can persist in the target area under certain conditions for considerable periods of time.

Biological agents, unlike most war gases, cannot be detected by the physical senses or by chemical detectors and can only be determined by laboratory examination. The time lag between exposure to a biological agent and the onset of disease symptoms will usually be a matter of days rather than hours, as is the case with most chemical agents. All persons will not be similarly affected even though exposed to the same dosage of biological agents. Some may escape disease entirely, some may have a very mild attack, and some may become seriously ill.

BIOLOGICAL AGENTS

Biological agents are divided into two main classes:

1. Living organisms or germs, and
2. the poisonous products or toxins which they produce.

Most germs are not harmful to man, animals, or plants. Many, in fact, are beneficial. For example, they are used in the manufacture of beer and the ripening of cheese. Actually only a few kinds of germs are capable of causing disease. The fact that germs are alive implies that they multiply, breathe, eat, grow, and die. They are very susceptible to their environment and require certain amounts of moisture, appropriate foods, the proper amount of light, and certain limits of temperature. When their surroundings are not suitable, they will die.

Practically all of these germs are killed by simple procedures known to all personnel. Boiling or adding chlorine tablets to canteens of water, cooking of food, exposure to sunlight, and use of soap and water are some examples.

Classification

Biological agents when used militarily can be classified on the basis of persistency, ability to spread from one person to another and their capability of producing a severe or mild disease. In general, any biological agent used by an enemy will undoubtedly possess one or more of these characteristics to a marked degree.

Persistency.—The persistency of an agent is proportional to the time it can endure in an effective state in the area of release. An agent able to resist adverse environmental conditions for long periods of time is classed as a persistent agent. Most organisms, or germs, on the other hand, are very sensitive to changes in their usual living conditions and will be rapidly affected by changes in temperature, food, moisture, light, or exposure to air. Such organisms are classed as nonpersistent agents.

Virulence.—Virulence of an agent is its ability to cause mild or severe disease. Highly virulent agents cause severe disease. Those of low virulence cause mild disease.

Ability to spread (communicability).—Communicable agents spread from man to man. Noncommunicable agents do not. Communicable agents may be spread in many ways, such as by contact, body excretions, cough and sneeze droplets in the air, and airborne clouds of dried material.

MEDICAL ASPECTS

Disease and Immunity

In order to produce disease or death, a biological agent must enter and establish itself within the body of a susceptible person so that it can grow, develop, and multiply in number. When the agent consists of living organisms, such as typhoid bacilli, this process is known as infection. On the other hand some germs manufacture poisons, or toxins, which produce disease when introduced into the body. In this instance the living agent need not necessarily enter the body, and the disease process known as poisoning is due entirely to the toxin. An example of this type of biological agent is the toxin produced by some bacteria when they grow in foodstuffs under certain conditions. This toxin contaminates the food and when taken into the body produces in individuals, who have little or no resistance to its action, a condition called bacterial food poisoning. Thus, whether the agent is a living germ or a toxin manufactured by a living germ, there are two factors concerned with its role in producing disease. First, penetration of the body by the agent and second, the susceptibility of the individual to the agent.

Routes of infection.—In order to produce disease, some biological agents must penetrate the human body in a specific manner. Others are effective by a wide variety of routes. Certain organisms must come in direct contact with the skin or mucous membranes, which are penetrated through existing small cuts, abrasions, and openings of sweat or oil glands or of hair follicles. Two diseases normally transmitted in this manner are boils and tularemia. Almost any object capable of producing penetrating wounds may be contaminated with bacteria capable sometimes of producing some specific disease, such as pusforming infections, lockjaw, or gas gangrene. Respiratory diseases, such as the common cold, influenza, pneumonia, and measles, usually are the result of breathing in small droplets of moisture containing the microorganisms which produce those diseases. Sometimes a disease is caused by inhaling dust contaminated with the infective agent. Intestinal infections, such as typhoid fever, dysentery, and cholera, are produced by eating foods or drinking water contaminated by the disease-producing bacteria. Likewise, some bacterial poisons, such as the botulinus toxin, normally enter the body in food by way of the mouth. Bloodsucking insects may introduce germs into the body while biting. Examples of diseases caused by this means are malaria, which results from the bite of a mosquito carrying the malarial organism; typhus fever, the organisms of which are carried by body lice; Rocky Mountain spotted fever, which is transmitted by wood ticks and dog ticks; and bubonic plague, which is carried from the rat to man by the rat flea. In biological warfare, agents which are normally introduced by one of these routes may be expected to be introduced through another.

Immunity.—A susceptible or nonimmune individual is a person who may develop the disease when he is exposed to the germ or toxin. Many persons, however, who have disease germs introduced into their bodies do not become ill, even

though they are susceptible. An immune person is one who does not develop the disease because his resistance is high. Immunity is specific; and because a person is immune to one disease does not mean he has immunity to any other, although immunity to many different diseases is usually present in the adult individual. Immunity to a disease may be the result of a previous attack of that disease, or in the case of certain diseases immunity may be produced by vaccines. The duration of immunity acquired in this manner depends upon the specific disease and can vary from a few weeks to many years. There is, in addition, another type of immunity which is inherited and common to a species or race. For instance, man is naturally immune to hog cholera, a highly fatal epidemic disease of pigs.

Qualities of infectious diseases.—An agent used in biological warfare will produce essentially the same type of illness as when acquired by natural means. The symptoms are those of a common infectious disease. Since the treatment for all such infections is medical aid, this will be sought in the normal fashion.

EMPLOYMENT

The preparation of an adequate defense against biological warfare requires an understanding of the types of munitions or means which may be used to disperse biological agents. An enemy might, for example, place biological agents as fillings in bombs, shells, aerial and ground spray tanks, and land mines. Such artillery or mortar shells or aerial bombs would probably be small, have a relatively low bursting charge, and would be used in large numbers rather than singly. They might be released in clusters which in turn would release smaller units. The shell case would be highly fragile and might be constructed of light gage metal, ceramic, glass, or plastic material.

New and unorthodox munitions might develop, especially for use as sabotage devices, such as ejection bombs which would not burst but would eject from the rear a vapor or blob of volatile material containing biological agents. Biological agents may be released from munitions as aerosols. Such clouds behave, in general, as do the clouds developed by chemical agents. The biological particles eventually settle out of the cloud and may remain active as surface contaminations for a considerable period of time. Biological attack with the munitions indicated might be utilized against strategic targets, against civilian population centers, and on a limited scale against large troop concentrations. Special devices might be employed for sabotage attack against selected targets.

Limitations.—Although the known disease-producing organisms are numerous, military requirements would limit the use of many of these organisms in biological warfare. This is due to the fact that most of these organisms are unable to survive for any extended period of time once they have been removed from their normal surroundings, exposed to direct sunlight, extremes in temperature, or to an area having insufficient moisture. In addition, there are many technical difficulties in preparation and delivery of the agent that will further limit the employment of this type of warfare

Military applications.—Although there has been some sporadic use of biological agents in the past, biological warfare has never been introduced on a large scale in combat. Because of the characteristics of these agents, biological warfare would probably be used offensively in many situations. As such, it would be used against amphibious concentrations, at points of embarkation, at beachhead areas, against mass concentration of troops in rear areas and centers of population, and as a means of attacking enemy economic resources necessary to the conduct of the war. Defensively, biological warfare might be employed in numerous situations, such as in the avenues of approach to fortifications, in sabotage efforts against forces in the zones of operations, interior, and communications, and in the process of a withdrawal or rout by an enemy.

DETECTION OF BIOLOGICAL ATTACK

Means of detection.—Means are provided for the early detection of biological attacks through the use of the normal clinical function of the medical service. Once a disease agent is known to be present, it can be controlled or destroyed and in practically every instance the prophylactic use of the proper antibiotic drug or drugs will protect

the individual from serious illness. Commanding officers will be informed immediately of any suspected use of biological agents and all available means of control and treatment will be instituted without delay in order to minimize any loss of troop effectiveness.

Principles of detection.—Defense against biological warfare involves three important echelons. First and earliest effective is intelligence. An accurate and early knowledge of a coming attack will alert available facilities and will best effect a defensive effort. Second is security. Lacking prior knowledge of an attack, physical prevention of the agent into an area of importance can reduce the effect of the attack.

If the attack is carried out in spite of the two above factors, the remaining defense is the biological defense. This depends upon the immunizations that have been received, effective preventive medicine measures and good health, attention to sanitation requirements, and an alert laboratory and medical staff to diagnose and begin treatment of the personnel at the earliest possible time. Each of these defenses depend upon the others and none can be ignored or delayed in planning if the defense is to be effective.

INDIVIDUAL PROTECTION

Individual protection against biological attack includes the use of protective equipment and the application of defense measures by the individual to reduce the effectiveness of disease-producing organisms to which he may be exposed. As in the case of exposure to any communicable disease, the natural resistance of the body and the maintenance of the body in the best possible physical condition constitute the first line of defense against biological agents. In general, individual protective equipment provided for defense against chemical attack will be used for defense against biological agents.

Gas mask.—Since the inhalation of airborne organisms is considered to be the greatest potential hazard in biological warfare, the gas mask is an important component of our protective equipment. A properly fitted mask which has been maintained in good condition will greatly reduce the possibility of inhaling infectious material in the air. Since the individual cannot detect the presence of biological agents, the use of the gas mask as well as the use of other protective equipment will be ordered by the commander in charge.

Protective clothing.—In order to produce disease, biological agents must gain entrance into the human body. A concentration of biological agents on the skin might in time be transferred to one of many points of entry of the body. Any type of clothing will provide some protection by reducing the quantity of agents coming in contact with the skin. The degree of protection afforded is dependent upon the imperviousness of the fabric and the number of layers of clothing being worn. Since this protective effect is due to the mechanical filtering or screening action of the cloth, it is important that shirt and jacket collars be fastened, sleeves rolled down and cuffs buttoned, trouser cuffs stuffed inside the tops of boots or socks, and all other garment openings tied or otherwise secured to minimize the entry of airborne organisms and reduce the risk of bodily contact with biological agents which may be present on the surface of the ground and in the air.

Military headgear helps safeguard the hair from heavy contamination, and ordinary gloves or mittens can be used as a protective covering for the hands. The impregnated type of clothing issued for protection against chemical agents provides a higher degree of protection against biological agents than that afforded by the ordinary uniform and will be used whenever available.

Procedures

Individual protection.—Upon notification of actual attack by biological agents or prior to entry into an area known to be contaminated by biological agents, the individual will:

1. Put on gas mask and check it for correct fit.
2. Button clothing. Tie clothing at wrists and ankles with string or extra shoelaces or utilize the special clothing which may have been provided for this purpose.
3. Put on gloves if available.
4. Continue the measures indicated in 1, 2, and 3 above as long as he remains in the contaminated area. Upon leaving the area, personnel decontamination measures will be undertaken to the extent the situation permits.

Personal decontamination.—The extent to which personal decontamination can be carried

out following actual or suspected exposure to biological agents will depend upon the existing tactical situation and the facilities at hand. If the situation permits, and bathing facilities and supplies of fresh clothing are available, clothing worn at the time of exposure should be removed and the body washed thoroughly with soap and water prior to donning fresh clothing.

COLLECTIVE PROTECTION

Collective protection against biological attack includes the use of protective equipment and installations and the application of defensive measures by the unit or group to reduce the effectiveness of disease-producing organisms to which it may be exposed. The use of shelters and standard military collective protectors, the protection of food and water supplies, the observance of the principles of military sanitation, the immunization of personnel, the use of protective and curative drugs, and the application of decontamination procedures are all part of collective protection.

Shelters.—In biological warfare, as in chemical warfare, any type of closed shelter offers a large measure of protection against contamination by an airborne agent. Whenever practicable, full advantage of the protection afforded by buildings, field fortifications, and closed vehicles should be taken during an actual or suspected attack with biological agents. The types of gasproof shelters designed for protection against chemical agents will afford a higher degree of protection against biological agents than that provided by ordinary closed shelters and will be used whenever available.

Preventive Medicine

Within the Armed Forces, as in civilian life, certain regulations have been issued to preserve the health of the individual and group and to prevent the spread of disease. The application of the measures required by those regulations, such as immunization, personal hygiene practice, and sanitary control of the environment, is called military preventive medicine. In most previous wars, more military personnel died of disease than of battle wounds. In World War II, however, this ratio was reversed largely by the use of vaccinations, chemotherapy, and wider application of sanitary and hygiene practices. Thus, preventive medicine constitutes an effective first line of defense against the ordinary occurrence of disease in the field or garrison, in the air, or ship, or ashore. In the event of threatened or actual employment of biological warfare, the continued use of the already known preventive medicine practices will assist materially in the reduction of primary casualties and also restrict the secondary spread of disease agents. Therefore, all military personnel should realize the importance of understanding the basic rules of preventive medicine in order that they will be able to carry out health regulations and orders intelligently and to cope with unforeseen situations.

Protection of Food and Water

Food and water supplies are especially susceptible to deliberate contamination. Strategic considerations render those items a particularly good target for sabotage within the communications zone of interior. The ordinary inspections and precautions routinely exercised within the military establishment to protect the sanitary quality of food and water will safeguard against most of the possible deliberate contaminants. Civilian supplies, however, all too frequently do not receive the same careful supervision and protection and must always be suspected of accidental or deliberate contamination. The safest rule is to consume only those foods and drinks received from military sources. For example, water is not necessarily pure just because it comes from a faucet. This is especially true in foreign countries where the practice of water purification is the exception rather than the rule.

Protection of water.—The military service will provide purified water. Chlorination is the almost universal method for sterilization of water. This procedure will destroy most of the biological agents. In exceptional cases, boiling may be required to insure proper decontamination of water and will be ordered when necessary. Frequent tests assure the safety of water supply at larger installations.

1. *General responsibilities and methods.*—In the field, as far as possible, water will be supplied by military water points. These provide for filtration in addition to chlorination and when properly

operated, the equipment is effective in removing organisms that produce disease. For the smaller groups of men, the Lyster bag is used for water purification. Under conditions of biological warfare, water may require purification by boiling.

2. For complete details on the use of the Lyster bag and other means of emergency purification of water in the field, and for small groups, see Chapter VI.

3. *Individual responsibilities and methods.*—Some biological agents may not be counteracted by normal water purification techniques. Accordingly, when biological agents have been used, all drinking water must be boiled unless otherwise directed.

Protection of food.—In the event of biological attack, or suspected attack, all appropriate foods believed contaminated will be boiled for at least ten minutes before consumption. If foods suspected of contamination may not be boiled as indicated, they must be destroyed.

Biological protection.—The medical officer has means at his disposal for the prevention, control, and treatment of diseases that will be encountered in biological attack. However, since none of these means will be 100 percent effective, all the previously outlined individual and collective protective procedures must be carefully employed as they may have a favorable influence.

Decontamination.—Decontamination measures on a broader scale for the entire unit will be carried out under command supervision. These will include decontamination of clothing, equipment, buildings and structures, terrain, water and food supplies, and the establishment of personnel decontamination stations.

TACTICAL PROTECTION

Tactical protection includes both active and passive defense measures taken to defeat enemy biological warfare action. Disposition of troops depend upon the local situation and the nature of the attack. In many cases, commanders will not know immediately which particular agent is being used, the degree of contamination, or extent of affected area. Both combat and technical intelligence reports from subordinate and higher headquarters will provide commanders with estimates of the situation and information pertaining to enemy biological activities and capabilities.

Responsibilities. — Within their respective spheres of responsibility, the surgeon and passive defense officer assist the commander and his staff in formulating plans and policies pertaining to defense against biological attack. A full understanding of the problems involved and the means of protection will aid in reducing the risk from this type of warfare. As is true and known by actual experience in chemical warfare, the maintenance and practice of a high level of individual and collective discipline will minimize the hazards to be encountered in biological warfare.

Chapter XVI

MEDICAL DEPARTMENT ADMINISTRATION

PRINCIPLES OF ADMINISTRATION

Medical department activities can be divided into administrative and professional. For the good management of Navy Medical Institutions, well-planned organization is essential. And of course, for small facilities, the organization can be quite simple. But larger hospitals and ships will have more complex plans of operation.

The task of the Medical Department is to prevent disease, and care for the sick and injured, in peace and war. And its organization must of necessity be flexible to accomplish this end.

Regardless of the size of the organization, the hospital corpsman should know his place and function, and fulfill it to the letter. And only by playing his part on the team efficiently can his department operate smoothly.

Organization of the Navy

The President of the United States is the Commander in Chief of the Armed Forces. The Department of Defense, headed by the Secretary of Defense, assists the President in his responsibility for national security. The Department of Defense includes three military departments—Department of the Army, Department of the Navy, and the Department of the Air Force—each headed by a Secretary appointed by the President and confirmed by the Senate.

The Department of the Navy consists of the office of the Secretary of the Navy; assisted by an Under Secretary; two assistants; an administrative assistant; Naval Command Assistant, who is the Chief of Naval Operations: Seven Bureaus, office of the Judge Advocate General; Commandant, U. S. Marine Corps; office of Naval Research; office of Naval Material.

Bureau of Medicine and Surgery

This Bureau directs the medical and dental services of the Navy. Its mission is to keep the Navy healthy and care for the sick and injured. It is concerned with all phases of life in the Navy and advises the Navy on all matters affecting the health of the personnel.

The Surgeon General of the Navy is the Chief of the Bureau. He is assisted by a Deputy and Assistant Chief of the Bureau and a staff. The duties of the Bureau are performed under the authority of the Secretary of the Navy, and all orders have the full force and effect of orders issued by the Secretary.

The Medical Department establishes standards for, and gives, physical examinations to persons entering the Navy; it oversees the sanitary and dietetic standards of the Navy; it protects the Naval establishment by advising regarding matters of safety and hazards to health.

The Medical Department provides medical and dental care for the sick and injured and trains its personnel to give this service.

The Bureau of Medicine and Surgery is the control or policy-making agency of the Medical Department. It directs and sets down policy for all medical services ashore and afloat, with a goal of highest quality and efficiency in medical operations.

The Bureau consists of the following offices:

Chief of Bureau (Surgeon General, U. S. Navy).

Deputy and Assistant Chief of Bureau.

Inspector General, Medical.

Inspector General, Dental.

Assistant Chief of Bureau for Personnel and Professional operations.

Assistant Chief of Bureau for Planning and Logistics.

Assistant Chief of Bureau for Aviation and Operational Medicine.

Assistant Chief of Bureau for Dentistry.

Assistant Chief of Bureau for Research and Medical Military Specialties.

In addition to these offices the Bureau is divided into divisions, branches, and units, as necessary.

District Medical and Dental Officers

The Navy Department assigns a district medical and dental officer for each naval district. They are designated as "District Medical Officer" and "District Dental Officer," respectively.

They are liaison officers for the Commandant with the Bureau on medical and dental matters.

The Bureau has direct control over certain naval medical centers and naval hospitals.

The Bureau has technical control over the medical and dental departments at shore establishments, on naval vessels, medical and dental field units with the Marine Corps, and advance base medical and dental components.

A medical officer, dental officer, or medical service corps officer, whichever is appropriate, is assigned as commanding officer or officer in charge of each activity over which the Bureau has management and technical control.

The medical officer and dental officer of a naval activity over which the Bureau does not exercise management control, are responsible to the commanding officer.

The Medical Department is comprised of five separate corps: (1) The Medical Corps; (2) Dental Corps; (3) Medical Service Corps; (4) Nurse Corps; and (5) Hospital Corps.

The Hospital Corps

The Hospital Corps is composed of enlisted rates and ratings and warrant officers and commissioned warrant officers divided into four groups which are classified by the Bureau of Naval Personnel as Hospital Corps, group X, Medical; Hospital Corps, group XI, Dental; Warrant Officers, Hospital Corps, and Commissioned Warrant Officers, Hospital Corps, 8171; and Warrant Officers, Hospital Corps (Dental Clerk), and Commissioned Warrant Officers, Hospital Corps (Dental Clerk) 8181. The following are the group X rates: Hospital Recruit; Hospital Apprentice; Hospitalman; Hospital Corpsman, Third Class; Hospital Corpsman, Second Class; Hospital Corpsman, First Class; and Chief Hospital Corpsman. These rates lead to Warrant Officer, Hospital Corps, 8171. The following are the group XI rates: Dental Recruit; Dental Apprentice; Dentalman; Dental Technician, Third Class; Dental Technician, Second Class; Dental Technician, First Class; and Chief Dental Technician. These rates lead to Warrant Officer, Hospital Corps (8181).

Enlistment, reenlistment, or extension of enlistment for personnel of the Hospital Corps is governed by instructions contained in the Bureau of Naval Personnel Manual.

Transfer of enlisted personnel for instruction at Hospital Corps schools upon enlistment or change of rate or rating shall be governed by current instructions of the Bureau of Naval Personnel.

Reference should be made to the Catalog of Hospital Corps Schools and Courses for courses of instruction currently provided for personnel of the Hospital Corps. When a member of the Hospital Corps has been found qualified by training or experience in any specialty, his commanding officer shall cause an entry to that effect to be made in his Service Record, upon approval of the Bureau of Medicine and Surgery.

Advancement in Enlisted Rates or Ratings

All candidates for advancement in enlisted rates or ratings in Group X, Medical, of the Hospital Corps must qualify by examination in accordance with instructions contained in the Bureau of Naval Personnel Manual, the Manual of Qualifications for Advancement in Rating, and current Bureau of Naval Personnel directives. An understanding of general naval activities as outlined in the Bureau of Naval Personnel Manual, and a thorough knowledge of the duties required of their particular rate or rating and the field allied to medicine in which they profess to be proficient, is required. The membership of examining boards when practicable shall consist of appropriate officers of the Medical Department, but in any case shall include at least one such officer.

Examination questions shall become broader in scope and thoroughness with each advancement in rate or rating. For this purpose, the Handbook of the Hospital Corps may be used as a general guide.

The examinations for technicians prescribed in the Manual of Qualifications for Advancement in Rating are for the purpose of determining special

technical qualifications only. Examining boards must be guided by the fact that a Hospital Corps technician may be assigned general Hospital Corps duties for an indefinite period in emergencies. An officially designated Hospital Corps technician may not be advanced in rate or rating unless he is thoroughly qualified to perform the general duties of that rate or rating, in addition to the duties of his technical specialty.

Warrant Officer, Hospital Corps

Chief petty officers and petty officers, first class, of Group X, Medical, of the Hospital Corps are eligible for appointment as warrant officers, Hospital Corps, subject to passing such physical, mental, moral, and professional examinations as are prescribed by the Secretary of the Navy and set forth in the Bureau of Naval Personnel Manual.

Appointment in Medical Service Corps

Commissioned warrant and warrant officers of the Hospital Corps, chief petty officers, and petty officers, first class, Group X, are eligible to take the examination for appointment as ensign in the Medical Service Corps, under the conditions as set forth in current directives.

Enlisted Rates and Ratings

The systematic training and instruction of enlisted personnel of Group X, Medical, for general service, is of great importance. The need for well-trained personnel in the chief and first class petty officer rates for vessels to which no medical officer is attached must be given special consideration. At all activities to which medical officers are attached, instruction in the duties of the personnel of the Hospital Corps, both practical and theoretical, shall be a matter of routine. At activities where medical officers are not available, or when it is not appropriate to assign them as instructors for the complete schedule of instruction, officers of the Nurse Corps, or officers of the Medical Service Corps, or personnel of the Hospital Corps may be assigned as instructors in the subjects in which they are qualified.

Instruction shall be continuous and progressive and shall cover the subjects in which proficiency is required for advancement in rate or rating and shall be given to enlisted personnel of all rates

below that of first class, at medical department activities ashore and afloat. Instruction shall include the indication for, and the technique of, the administration of blood substitutes, glucose solutions, and normal saline solution. This and similar instruction in the most recently accepted methods of treatment is especially important in the training of personnel who may be ordered to independent duty.

Commanding officers and heads of medical departments shall provide for rotation of assignments of personnel of the Hospital Corps in order to acquaint them with all phases of their duties.

Enlisted personnel of the Hospital Corps will not be assigned to training in more than one technical specialty, other than medical field technician, except upon authority of the Bureau. Any technician may be recommended for training in medical field service.

The Bureau of Naval Personnel will supply Navy training courses for Hospital Corps rates and ratings, and all general service ratings, when officially requested by a ship or station. Upon the successful completion of a training course and the practical factors, an entry shall be made on the appropriate page in the service record and a training course certificate issued by the commanding officer.

DUTIES OF GROUP X, MEDICAL

General Duties.—The duties of enlisted personnel, group X, Medical, Hospital Corps, are prescribed by the Surgeon General. Detailed duties at any particular station are those prescribed by the senior medical officer attached for duty, the commanding officer, or other competent authority. Enlisted personnel of group X are assigned duties in general nursing, administration, and as technical assistants to medical or other officers. They shall be assigned to the medical department of the ship or station to which attached.

When qualified, they may be assigned independent duty on small ships and stations without a medical officer. They may be assigned duty with medical detachments of the Marine Corps or amphibious forces, with the submarine service, naval aviation, or with naval medical research.

Hospital corpsmen are restricted, in view of the limitations of the Geneva Convention, from assignment to any duty of a combatant nature. Enlisted personnel of group X on independent duty or serving in the absence of a medical officer shall carry out the functions of the Medical Department of the Navy insofar as their qualifications allow. When personnel of the Hospital Corps are called upon to sign original entries in health records, or to undertake other professional or administrative duties, they shall perform these tasks only when a medical officer is not available.

Night Duty.—Normally, enlisted personnel of the Hospital Corps shall not be required to perform night duty for a period exceeding 1 month and shall not ordinarily be called upon for night duty more frequently than 1 month out of every three. In tropical stations the period of night duty shall be of shorter duration. Personnel relieved from night duty shall not, except in emergency, be reassigned to duty for 48 hours thereafter.

Hospital Recruit (HR) or Recruit for Hospital Apprentice—will be enlisted and sent to a naval training center with other recruits for basic training and to determine the individual's fitness for service. When selected for training as a hospital corpsman for general service, the individual will be sent to a Hospital Corps school for special training. Upon completion of this training, or when otherwise directed by the Chief of Naval Personnel, the individual's rate will be changed to a Hospital Corps rate in the Medical Group.

Hospital Apprentice (HA)—Upon first reporting, hospital apprentices shall be assigned to ward duty for elementary instruction in practical nursing procedures. They shall be retained on ward duty insofar as practicable for at least 3 months. They may then be assigned as junior assistants in wards, clinics, and administrative divisions. Assignments shall be rotated not less often than every 3 months insofar as practicable.

Hospitalman (HN).—Hospitalmen shall be assigned the more advanced nonpetty officer duties in the various wards, clinics, and administrative divisions of medical department activities both ashore and afloat. They shall be assigned junior nursing, first aid, dressing room, operating room, dietary, and junior administrative clerical duties. Assignments shall be rotated insofar as practicable every 4 months. They may be assigned to certain courses of formal medical-technical instruction open to nonpetty officers of the Hospital Corps.

Hospital Corpsman, Third Class (HM3).—Shall be assigned duties commensurate with their rate such as watch stander or assistant to the head of a ward, clinic, or administrative section at a naval hospital, or medical department of an activity ashore or afloat. Assignments shall be rotated, insofar as practicable, but not less often than every 6 months.

Hospital Corpsman, Second Class (HM2).—Shall be assigned duties commensurate with their rate. They may be assigned as first or second assistant to the head of a ward, clinic, or administrative section at a naval hospital, or medical department of an activity ashore or afloat. They are eligible for assignment to the advanced formal course of instruction in the general duties of a rate in the Hospital Corps. Assignments shall be rotated insofar as practicable, but not less often than every 12 months.

Hospital Corpsman, First Class (HM1).—Shall be assigned duties commensurate with their rate. They may be assigned as senior hospital corpsman in a ward, clinical service, or administrative section or division of a naval hospital, or medical department of an activity ashore or afloat. They may be assigned independent duty, in the absence of a medical officer, on small ships or stations. They are eligible for assignment to the various formal courses of instruction in Hospital Corps technical specialties and the advanced formal course of instruction in the general duties of personnel of the Hospital Corps. When eligible they may be considered for promotion to warrant rank in the Hospital Corps.

Chief Hospital Corpsman (HMC).—Shall be assigned duties commensurate with their rate as a chief petty officer. They may be assigned as chief petty officers in charge of certain wards, clinical services, and administrative sections of a naval hospital, or medical department of an activity ashore or afloat. They may be assigned as medical chief master at arms. They may be assigned independent duty, in the absence of a medical officer, on small ships and stations. They are eligible for assignment to the various courses of medical-technical instruction in Hospital Corps technical specialties and to the advanced course of

instruction in the general duties of the Hospital Corps. They are eligible for consideration for promotion to warrant rank in the Hospital Corps.

Special assignments. — Hospital corpsmen trained and designated in medical technical specialties shall be assigned, insofar as practicable, to duty involving their technical specialty. They may, in an emergency, however, be assigned to the general duties required of all rates or ratings in the Hospital Corps, according to the needs of the service.

Duties of Warrant Officers

Warrant officers and commissioned warrant officers, Hospital Corps, are general administrative assistants to medical officers; must be thoroughly familiar with medical property accountability, personnel management, and administrative procedures; are accountable for all equipment and stores in their charge, exercising personal supervision over their condition and the economical expenditures thereof, reporting any deficiencies to the medical officer; when attached to a unit or an activity going into or out of commission, personally supervise the checking and testing of all equipment in their department. They take such battle station and station for daily quarters as may be assigned by the commanding officer.

Wherever officers of the Medical Service Corps are assigned to duty, warrant and commissioned warrant officers, Hospital Corps, may serve as assistants to such officers.

SPECIAL TRAINING AVAILABLE TO ENLISTED HOSPITAL CORPSMAN—MEDICAL

Type of training	School class	Length of course
Hospital Corps School (basic)	A	20 weeks.
Hospital Corps School	B	26 weeks.
Aviation medicine	C	4 months.
Blood bank	C	2 months.
Bone bank	C	4 months.
Chemistry	C	1 year.
Clinical laboratory	C	Do.
Deep sea diving	C	6 months.
Electroencephalography	C	4 months.
Environmental sanitation	C	5 months.
Medical administrative	C	9 months.
Medical duplicating	C	1 year.
Medical field service	C	30 days.
Medical equipment maintenance	C	44 weeks.
Medical photography	C	6 months.
Neuropsychiatry technic	C	4 months.
Occupational therapy	C	6 months.
Operating room	C	Do.
Optometric fabrication	C	10 months.
Orthopedic appliance technic	C	6 months.
Pharmacy technic	C	9 months.
Physical therapy	C	6 months.
Radioactive isotope therapy	C	32 weeks.
Submarine medicine technic	C	5 months.
Urological technic	C	6 months.
X-ray technic	C	Do.

Note.—Location, convening date, and place of training shall be in accordance with current directives.

HOSPITAL CORPS, GROUP XI, DENTAL

The membership of examining boards for enlisted personnel, group XI, Dental, shall, when practicable, consist of dental officers; but in any case there shall be at least one dental officer member. Medical Service Corps officers qualified in dental techniques, warrant officers, Hospital Corps, and commissioned warrant officers, Hospital Corps, may be included in the membership of examining boards when sufficient dental officers are not available. Enlisted personnel of group XI, Dental, of the Hospital Corps, shall not be required to prepare themselves for general Hospital Corps duties as a prerequisite for advancement in rate or rating, but shall be trained in the principles of minor surgery and first aid.

Specialized technical examinations.—All personnel of the dental rating group (group XI) who have been designated by the Bureau in a technical specialty will be given technical examinations for advancement in rating as prescribed in the Manual of Qualifications for Advancement in Rating in which the technical specialty will be emphasized.

Warrant Officer, 8181 (Dental Clerk)

Chief petty officers and petty officers, first class, of group XI, Dental, of the Hospital Corps, are eligible for appointment as warrant officers, Hospital Corps (Dental Clerk), subject to passing such physical, mental, moral, and professional qualifications as are prescribed by the Secretary of the Navy, and set forth in the Bureau of Naval Personnel Manual.

Medical Service Corps

Commissioned warrant and warrant officers, Hospital Corps (Dental Clerk), and chief dental technicians and dental technicians, first class, are

eligible to take the examination for appointment as ensign in the Medical Service Corps as set forth in current directives.

Training of Group XI

At all activities to which one or more dental officers are attached, instruction in both practical and theoretical dental technical procedures shall be a matter of routine. Officers of the Medical Service Corps who are qualified in dental techniques, warrant and commissioned warrant officers, Hospital Corps (Dental Clerk), or qualified dental technicians, may be detailed as instructors of enlisted personnel, group XI, Dental, for advancement in rating. Dental technicians who have not become qualified as prosthetic or equipment repair specialists may be recommended for training in these technical specialties.

Transfers of enlisted personnel, group XI, Dental, to dental technician schools upon enlistment or change of rate or rating shall be governed by current instructions of the Bureau of Naval Personnel.

Courses of instruction in dental technique are available at the U. S. Naval Dental School, National Naval Medical Center, Bethesda, Md.; at the U. S. Naval Dental Technician School, U. S. Naval Training Center, Great Lakes, Ill.; at the U. S. Naval Dental Technician School, U. S. Naval Training Center, San Diego, Calif.; U. S. Naval Dental Technician School, Bainbridge, Md.; and at such other dental activities as may be designated by proper authority. When persons holding rates or ratings of group XI have been found qualified by training or experience in dental technical specialties, their commanding officers shall cause entries to that effect to be made in their service records.

Duties of Group XI

General duties of enlisted personnel, group XI, Dental, Hospital Corps, are prescribed by the Surgeon General. Detailed duties in any ship, station, or naval hospital are prescribed by the senior dental officer attached for duty, the commanding officer, or other competent authority. Enlisted personnel of group XI, Dental, are assigned to dental departments of ships or stations and to dental services of naval hospitals as technical assistants to dental officers in keeping with their abilities. They may be assigned duty with dental detachments of the Marine Corps or Naval dental research. Dental technicians shall not be required to perform duties for which they are not professionally qualified.

Dental Recruit (DR) or Recruit for Dental Apprentice.—Will be enlisted and sent to a naval training center for basic training. Upon completion of recruit training, and if considered to have aptitude, the individual will be sent to a dental technician school. Upon completion of this training, or when otherwise directed by the Chief of Naval Personnel, the individual's rate will be changed to dental apprentice.

Dental Apprentices (DA).—Are trained for advancement to dentalman. They perform elementary routine duties as dental operating room and clerical assistants.

Dentalmen (DN).—Are in training for advancement to the rating of dental technician. In addition to acting as dental operating room assistants, they perform routine clerical duties.

Dental Technicians, Third Class (DT3).—Perform dental clinical and clerical duties such as assisting dental officers in the treatment of patients, giving oral prophylactic treatments under the supervision of dental officers, rendering dental first aid, and carrying on dental department administrative assignments. As junior petty officers, they may assist with dental property records and may be placed in charge of dental supplies issue rooms. In addition, dental technicians, third class, qualified in other dental specialties will perform those duties as outlined in Bureau of Naval Personnel Qualification Manual.

Dental Technicians, Second Class (DT2).—Shall be assigned duties requiring more experience, training, and ability. They render dental first aid, administer dental prophylactic treatments under the supervision of dental officers, perform routine clerical, property, and clinical duties, take charge of dental watch sections, act as mate of the day, and supervise and instruct lower rated men in all phases of their duties. In addition, dental technicians, second class, qualified in other dental specialties will perform those duties outlined in Bureau of Naval Personnel Qualification Manual.

Dental Technicians, First Class (DT1).—Shall be assigned duties commensurate with the

rate of an experienced, mature, petty officer. They may be assigned in charge of a record office, a property section, or a dental prosthetic laboratory. They shall prepare watch, quarter, and station bills, instruct and supervise lower rated men, render dental first aid, and administer dental prophylactic treatments under the supervision of dental officers. They shall act as mate of the day or assistant chief of the day. When eligible, they may be considered for promotion to warrant officer, Hospital Corps (Dental Clerk). In addition, dental technicians, first class, qualified in other dental specialties will perform those duties as outlined in Bureau of Naval Personnel Qualification Manual.

Chief Dental Technicians (DTC).—Shall be assigned duties commensurate with their rate as chief petty officer. They may be assigned as chief petty officer in charge of a dental ward, record office, property section, or dental prosthetic laboratory. They may be assigned duty as instructors in dental technician schools. They shall prepare watch, quarter, and station bills, detail enlisted personnel with a view to their most efficient employment, and instruct lower rated men. They shall supervise all phases of technical procedures, render dental first aid, and administer dental prophylactic treatments under the supervision of dental officers. They are eligible for consideration for promotion to warrant officer, Hospital Corps (Dental Clerk). In addition, chief dental technicians qualified in other dental specialties will perform those duties as outlined in Bureau of Naval Personnel Qualification Manual.

Special assignments. — Dental technicians trained and designated in dental technical specialties shall be assigned, insofar as may be practical, to duty involving their technical specialty. They may when needed, however, be assigned to the general duties required of all dental technicians.

Duties of Warrant Officers (Dental Clerk)

Warrant officers and commissioned warrant officers, Hospital Corps (dental clerks), are administrative assistants to dental officers; supervise and perform clerical procedures; supervise dental laboratories; must be thoroughly familiar with dental property accountability, personnel management, and clinic supervision; are accountable for all equipment and stores in their charge, exercising personal supervision over their condition and the economical expenditure thereof, reporting any deficiencies directly to the dental officer; when attached to a unit or an activity going into or out of commission, personally supervise the checking and testing of all dental equipment. They take such battle station and station for daily quarters as may be assigned by the commanding officer.

Whenever officers of the Medical Service Corps are assigned to duty in dental activities, warrant and commissioned warrant officers, Hospital Corps (dental clerks), may serve as assistants to such officers.

Special training available.—Dental technician; dental technician, supervisor; dental technician, chemist; dental technician, clinical laboratory; dental technician, research; dental technician, administration; dental technician, stenographer; dental technician, clerical; dental technician, property and accounting; dental technician, repair, supervisor; dental technician, repair; dental technician, repair, basic; dental technician, X-ray; dental technician, prosthetic, supervisor; dental technician, prosthetic; dental technician, prosthetic, basic; dental technician, pharmacy; and dental technician, acrylic eye illustrator.

FOOD SERVICE DIVISION

In naval hospitals, one of the major administrative problems is the feeding of the patients and staff. Food that is well prepared and properly served is not only a major factor in the promotion of good morale, but is one of the many factors to be considered in the treatment of the patient.

Funds allotted for rations in naval hospitals are at all times adequate to maintain a standard of highest quality. It is the responsibility of the food service officer to serve meals that consist of a well balanced ration properly prepared, is pleasing to the senses, and that is sufficient in quantity to satisfy the appetite.

Organization of Food Service Division

The general supervision of the Food Service Division devolves upon the food service officer who is usually a member of the Medical Service Corps or Hospital Corps. He is directly responsible to the commanding officer. The general and specific

duties of the food service officer are outlined in the Manual of the Medical Department.

The Therapeutic (Special) Diet Kitchen is also a part of the Food Service Division and is under the general supervision of the food service officer who is responsible for all equipment and personnel assigned to duty therein.

For greater efficiency in management the Food Service Division may be divided into:

1. The Administrative and Stores Branch.
2. The Food Preparation and Service Branch.
3. The Therapeutic Diet Branch.
4. The Nurses' Quarters Mess.

The **Administrative and Stores Branch** embraces those duties relative to the proper bookkeeping, accounting, procurement, receipt, storage, and issue of all provisions and supplies, preparation of watch and detail lists, preparation of necessary reports and returns and the administration of civilian personnel records of performance and attendance.

The **Food Preparation and Service Branch** is concerned with the preparation, cooking, and serving of food, meats and bakery products, as well as cleaning and care of all equipment, utensils, and spaces in the department.

The **Therapeutic Diet Branch** prepares and serves the therapeutic diets under a dietitian.

The **Nurses' Quarters Mess** shall be the administrative responsibility of the Food Service Division in accordance with the Manual of the Medical Department.

The Administrative section is under the direct supervision of the senior hospital corpsman assigned the Food Service Division. He is responsible to the food service officer for the following:

Supervise the operation of the administrative section and to promote efficiency in its management.

For the proper performance of duty of all military personnel and group IVb employees.

Training of enlisted personnel in the division in all phases of their duties.

Assigning details to adequately cover all sections at all times.

Submission of watch lists and liberty lists.

Daily inspection of all equipment, fittings and cooking utensils, not only for cleanliness but operating efficiency.

Is responsible for the work of the group IVb employees, and to see that it is accomplished in an acceptable manner.

Assists the food service officer in the preparation of estimates for ordering provisions and supplies.

The receipt and verification of weights and amounts of provisions and supplies received.

Perform such other duties as the food service officer assigns.

The duties of the hospital corpsmen in the Food Service Division vary with the size, the location, physical facilities, and the organization of the hospital. They may be assigned duty in the offices, storerooms, refrigerators, or the master at arms of mess halls. They may be required to operate cash registers for sale of meals, and check those entering the mess hall who may be on commuted rations. The methods used in the various hospitals vary in accordance with the number of personnel, organization, and other local conditions.

Upon being assigned duty in the Food Service Division, the hospital corpsman should report to the senior chief for instructions pertaining to his detail. Regardless of what this detail may be, the first requisite is cleanliness. The nails should be kept short and clean, the hands should be well washed, especially after visiting the toilet.

If detailed to the storerooms, nothing should leave that storeroom without an approved voucher. Stores being received should be properly checked in and entered in the books. Strict accounting is extremely important. Case goods should show date of receipt on outside of case. Use oldest supplies first.

All material in storerooms should be stored on platforms raised from the flooring. Sufficient room should be left to pass between cases and wall. This not only facilitates cleaning, but aids in case of taking inventories and in preservation of material.

The principal working force of the Food Service Division consists of civilians; usually either a steward or chief cook being the supervisor, who is directly responsible to the food service officer. In addition there are cooks, bakers, meat cutters, and mess attendants. These all perform duties in accordance with local organizational plans and orders.

Civilians work 8 hours per day, 5 days per week. Watches must be arranged to comply with work-

ing hours, yet cover all necessary details. This is a complicated duty, as split shifts cannot be worked.

On week ends and holidays, enlisted personnel are usually required to take over all administrative work that is usually performed by civilian personnel. This is done usually by the watch on duty. Having to assume these functions, makes it necessary for all hospital corpsmen in the division to have a good working knowledge of all departments.

It is one of the duties of the senior chief hospital corpsman to train all personnel in the division so that they can accomplish this work properly and efficiently in accordance with local policy and orders.

All hospital corpsmen should be familiar with instructions contained in the Manual of the Medical Department, the Manual of Naval Hygiene, and current directives which pertain to this division.

Procurement and Accounting

All provision items for use in the Food Service Division are procured as an appropriational charge to "Medical Care Navy," for the current fiscal year, except items received from other medical department activities that absorbed the appropriational charge upon original procurement of items so transferred.

The allotment for provisions granted to naval hospitals is included in the approved annual estimate for the approaching fiscal year and is divided into quarterly apportionments based upon past expenditures, current per diem ration allowance, and the estimated number of subsistence days for the period.

The Food Service Division officer is responsible for the expenditures and accounting for these funds.

Procurement of provision items is accomplished by:

1. Transfer from a Naval or Federal supply activity.
2. Purchase under authority of contracts let by local supply officers.
3. By contracts effected by the U. S. Army quartermaster market centers through Navy market offices.
4. By purchases in open market for designated special diet items.

Items of dry and fresh provisions may be obtained from designated supply activities by transfer, on requisition, or invoice forms, various supply department forms may be used, depending upon which the supply officer specifies. The supply officer should be consulted for local procedures in ordering provisions and dry stores procured from him.

To record the procurement and expenditures of provision items, books of account are maintained in the Food Service Division. These accounting records must be on a current daily basis and must reconcile with the stores account in the hospital general ledger accounts.

The procurement and accounting sections should be located together under the direct supervision of the senior chief hospital corpsman. This makes it mandatory for the hospital corpsman to have a knowledge of bookkeeping, accounting procedures, and a thorough knowledge of the accounting methods used in the Food Service Division of hospitals.

Most hospitals now use the individual card system. One card for each item of provisions, which show the daily receipts and expenditures of that item.

The daily receipt and expenditure voucher is the book of original entry and has the effect of a general journal. The data supporting the receipt entries are obtained from dealer's delivery ticket; inspection reports, purchase orders, or other receipted vouchers. Entries for the expenditures are made the day the item is expended and are obtained from approved expenditure vouchers, transfer vouchers issued, and approved surveys of provisions. These are the only three methods of expenditure of provisions permitted from the provision storerooms. In addition to the receipts and expenditures, the receipt and expenditure voucher shows the accumulated receipts and expenditures, total monetary value only, for the current month and quarter; the totals of the number of rations for the day, month, and quarter: and the cost of the ration for the day, month, and quarter.

A full explanation of the procedures used in the books of account is impractical. The hospital corpsman is referred to the Manual of the Medical Department and the Bureau of Medi-

cine and Surgery instructions and notices for generalizations of procedures. The only practical method of learning these procedures is assignment for duty in the various sections of the Food Service Division.

Food Inspection

The Medical Department is responsible for the inspection of all foods which are used in the Navy. This is especially important to individuals on independent duty on small craft in the tropics. It must be remembered that in the tropics, night soil, or human excreta, is frequently used as fertilizer. This is an excellent method for the transmission of certain diseases, especially dysentery. In these tropical countries, vegetables which are not to be cooked well, should not be permitted on board. Any fruits which do not require peeling should not be used. Even these should be inspected closely for breaks in the skin, and should be placed in disinfecting solutions before use. It is especially important to impress these factors on the members of the crew, to prevent them from consuming fruits and some types of vegetables while ashore. The hospital corpsman is referred to the Manual of Naval Hygiene for full discussion of these factors.

Meats used for food purposes generally come from the flesh of beef, swine, lamb, fish, and fowl, and flesh may be defined as any edible part of the striated muscle of an animal.

All meats received at consumer activities have been inspected by an inspector of the Meat Inspection Division, Department of Agriculture. All meats accepted in the naval service must bear this stamp.

Meat prepared for market may be fresh, prepared, or meat by-products. Fresh meat is meat that has been cut into wholesale or retail cuts and chilled or frozen.

Beef is derived from the carcasses of:

Steers.—Adult males of bovine species, castrated when young.

Heifers.—Young females of bovine species not fully matured, which have never borne young.

Cows.—Mature females of bovine species, which have usually borne young.

Bulls.—Mature males of bovine species.

Stags.—Males of bovine species castrated after reaching maturity.

Beef is graded on a composite evaluation of three general grade factors: Conformation, finish, and quality.

Conformation.—Pertains to the form, build or shape of the carcass. Breeding is a chief factor influencing conformation, and the best conformation is found in beef breeds. As carcasses decrease in conformation, the grade lowers. Quality of beef is applied to lean meat, fat, and bone. The quality of lean meat is indicated in its color and texture. Better quality beef has fat streaks interspersed with the lean meat, known as "marbling," and the color is bright. Darker colored meat is indicative of age or of a lower quality, and coarseness of texture and toughness is associated with dark colored meat.

Quality of fat is indicated by the texture without regard to color. Fat may be abundant and of a firm, brittle and somewhat waxy nature for external fat, or slightly waxy or rough as applied to internal fat.

Quality of bone refers to color, texture and to some extent, size. The younger the animal, the softer the bone; the red color is more pronounced and the spines of the vertebrae are tipped with white cartilage. As the animal matures the bones turn whiter and harder, and the cartilages gradually ossify. Finish refers to the quantity of fat on the carcass and the distribution of fat. On external surfaces of beef animals, fat becames more evident as the animals near maturity. Young animals have relatively little fat distribution, while the older animals of high quality have carcasses well covered with fat. Lower grades of carcasses show proportionately less distribution of fat, including marbling.

There are seven grades for beef from steers and heifers, and six grades for beef from cows, bulls, and stags. These are Prime, Choice, Good, Commercial, Utility, Cutter, and Canner. Cow, bull, or stag is not eligible for Prime grade. Only beef produced from steers and heifers will qualify for Prime grade.

Inspection of beef to determine the different classes and grades, requires long experience and a thorough knowledge in this field. In the United States, no meat should be accepted that does not bear the U. S. Agriculture Department stamp.

Veal carcasses are well nourished and carry considerable fat. The flesh is light colored and

fine grained. Calf carcasses are usually heavier in weight, not so well nourished and deficient in fat covering. Veal is the flesh of very young bovine animals, usually not over 12 weeks old. The largest percentage of veal comes from animals 3 to 6 weeks old. Calf carcasses are usually coarser in texture and the flesh is a deeper red color.

Pork is the meat of swine. It is paler in color than veal, has considerable fat. Pork cuts come from the carcasses of barrows, gilts, and sows. Only pork from barrows and gilts is used in the Navy. Because of sexual characteristics the meat of stag and boar carcasses usually does not enter into commerce at all. The flesh from these animals has a strong urinous odor when being cooked. Carcasses of good quality should be in good condition, sweet, sound, and free from bruises and discoloration. Oily and soft cuts, those with dark flesh, or with thick rind and coarse muscle fiber should not be accepted.

Lamb is a general term which refers to the flesh of young animals of the ovine species of both sexes up to about 12 months of age. Mutton carcasses are from animals of the ovine species which have passed the lamb stage. Lamb carcasses are distinguished from mutton by their smaller and softer bones, lighter colored flesh, softer and whiter internal and external fats, smaller size of carcasses and cuts, and by the "break joint" in the front legs. Lamb foreleg joints break into four well defined ridges, which are smooth, moist, and red with blood. In older animals the break joint is less well defined, and the ridges more porous due to the hardening of the bones. The break joint is totally absent in mature mutton.

Fish is purchased in fresh, frozen, and canned form. Of the many varieties of fishery products other than fish itself, fresh and canned oysters and shrimp are the chief items procured.

Conditions in fish are generally determined by the degree of freshness: fresh, stale, or putrid. Putrid fish are unsafe for eating. Putrid fish and those showing advanced stages of staleness should be rejected.

Fresh fish have a bright appearance, the scales are firmly adherent and glittering, and the eyes are outstanding and full. The gills have a bright color and no odor, and gill covers and mouth are closed. The abdominal walls are firm and elastic, with no evidence of bloating and no discoloration. The flesh is firm and elastic and tight on the bones. There is a fresh, characteristic smell. When laid across the hand a fresh fish will not bend and it sinks in water.

Stale fish have a duller appearance. The scales are more easily removed, and the surface of the body may be slightly slimy or smeary, or abnormally dry. The eyes are red-bordered and the cornea cloudy. The gills are pale yellow, dirty or grayish red, and covered with slime of a disagreeable odor. The body feels bony and bends easily, especially at the tail end. Finger impressions are easily made in the flesh and remain. The flesh is soft and easily removed from the bone. The fish floats in water.

Putrid fish have lost all brightness and luster. The color is dull and lifeless. The scales are loose and covered with a slime of offensive odor. The eyes are sunken down, or completely gone. The body is flabby. The abdominal walls are soft, pulpy, and discolored. The abdomen of round putrid fish is bloated or may even have burst. Putrid fish float on water.

Frozen fish.—A fairly accurate check may be made of frozen fish by drilling three-fourths inch deep holes in them with a small three-eighths inch electric drill. The drill should be allowed to spin in the hole for a few seconds. Deteriorated fish will be recognized by a fleeting but unpleasant odor in the hole.

Oysters should be strictly fresh shucked, solid pack, free from chemical preservatives and added water, and should not have been placed in direct contact with ice. They should be packed in metal 1-gallon cans, refrigerated or surrounded by ice.

Poultry comprises chickens, turkeys, ducks, geese, guinea fowl, and pigeons. Chickens and turkeys are the chief items procured. Normally, the purchase of chickens is limited to broilers, fryers, fowl, and roasters. The purchase of turkeys is usually confined to young toms and hens.

Two kinds of dressing are permitted for chickens by Federal specifications:

Dressed.—Are undrawn chickens which have been killed, bled, and plucked.

Eviscerated.—Are chickens which have been prepared from dressed chickens which have been singed and from which the head, shanks at the hock joint, crop, windpipe, esophagus, entrails,

gallbladder, lungs, kidneys, and oil gland have been completely removed. The carcass and the giblets (heart, liver, and gizzard) should be thoroughly cleaned and drained. The giblets wrapped in nonabsorbent paper and placed in body cavity. The product should be chilled immediately, until delivery.

Four types of chickens

Type I.—Fresh chilled, cooled immediately after slaughter, kept at a temperature not above 45° F. and delivered within 48 hours.

Type II.—Fresh chilled-cooled by refrigeration, but without the tissues containing ice crystals. Carcasses should show no evidence of having been frozen or defrosted.

Type III.—Fresh hard chilled are cooled by dry refrigeration to the extent that the carcasses are solidly frozen, and held for not more than 2 months. The containers should be plainly marked with date of slaughter.

Type IV.—Storage are solidly frozen while in excellent condition and held for not more than 10 months. Fresh hard-chilled carcasses which show evidence of deterioration from freezing may be classed as storage stock if solidly frozen at time of delivery. The containers should show the date of slaughter, although this is not a requirement.

Turkeys are dressed and are of the same types as chicken.

Eggs are purchased according to specifications and should be weighed and candled. The specifications will state the weight per crate, and the size air bubble permitted in the type of egg purchased.

For further information on inspection of foods, requirements and specifications, reference should be made to the Manual of Naval Hygiene and Sanitation, Federal Specifications on Food, if available, and Joint Army and Navy specifications.

SPECIAL SERVICES

The primary purpose of the Navy is the maintenance of the fleet in a state of readiness at all times. Fleet Admiral Chester W. Nimitz, USN (Ret.), stated, "The majesty of the ships of the United States Fleet is exceeded only by the fighting spirit of the men of the Navy. Stout ships and stalwart men—physically fit and mentally alert—are an unbeatable combination." The Navy has accepted the responsibility of providing for the total needs of the individual. A commanding officer is responsible for the entire function of his command, including matériel and men. It is this important human element that the "special services" program deals with.

The objective of the special services program is to provide fun and enjoyment for all hands during off-duty hours. Through the special services program, library services are offered.

The recreational-physical fitness section of special services provides entertainment, motion pictures, armed forces radio service, athletic sports, hobby crafts, theatricals, and music. The program is planned to serve the needs and interests of all naval personnel. Contacts are maintained with civilian schools, colleges, and professional organizations to keep abreast of current programs, research, and physical fitness duties.

Each naval activity shall have a special services officer who shall be responsible for instituting the special services program and maintaining it in a high degree of efficiency. Suitable assistants shall be assigned to aid him in the execution of the program. Personnel assigned to this duty shall keep themselves informed of current directives of the Chief of the Bureau of Naval Personnel.

CORRESPONDENCE

Official correspondence includes all recorded communications sent or received by a person in the Naval Establishment in the execution of the duties of his office. Correspondence prepared in the Naval Establishment consists of two principal types—the naval form and the business form. All official correspondence shall be prepared in accordance with the Navy Correspondence Manual.

The naval form is used in preparing a regular naval letter, joint letter, multiple address letter, circular letter, endorsement, speedletter, or memorandum addressed to an official or activity within the Naval Establishment.

A naval letter is a formal means of communication within the Naval Establishment. It may also be used for correspondence with other agencies, either governmental or nongovernmental, that have adopted the same form.

A joint letter is a naval letter signed by officials of two or more activities that are concerned with a particular subject or administrative problem common to the activities.

A multiple address letter is a naval letter addressed to two or more activities which are individually identified in the address or addressed as a group.

A circular letter is a naval letter having distribution to one or more groups of activities. These activities are not listed individually but are addressed as a group, such as "All Cruisers, Atlantic Fleet," or "Commanders, All Naval Shipyards."

An endorsement is a form of the naval letter indicating approval, disapproval, comment, or other action, that is stamped, written, or typed as an addition to a letter which, by nature of its subject matter, must be referred to one or more activities before it is forwarded to its final destination.

A speedletter is a brief, informal means of direct communication by mail within the Naval Establishment. If determined suitable by the originating office, a speedletter may be addressed to correspondents outside the establishment.

A memorandum is an informal means of communication between divisions, branches, sections, or individuals, within the same bureau or activity, and between fleet or force commanders and units of command under their jurisdiction.

The business form is used in preparing letters addressed to persons or agencies outside the Naval Establishment that have not adopted the naval form of letter.

A form letter is a letter, either in naval form or in business form, printed or otherwise processed and stocked in advance of its actual use. The four types extensively used are:

The **plain form letter** which requires no typing in the body of the letter.

The **fill-in form letter** which requires only certain sections of the letter to be typed or filled in by hand.

The **reference-number form letter** which contains numbered optional statements at the end of the letter. The statement which applies is merely referred to by number in the body of the letter.

The **check-list form letter** which contains a list of frequently used statements with a box in front of each for checking whenever that particular statement is applicable.

A message is an official communication in brief form transmitted by rapid means other than telephone. Messages are prepared in accordance with instructions contained in communication instructions and related publications issued by the Chief of Naval Operations.

Classified matter is construed to mean information or material in any form or of any nature which in the public interest must be safeguarded in the manner and to the extent required by its importance. The classifications are top secret, secret, confidential, and restricted.

Top secret is information and material (matter), the security aspect of which is paramount, and the unauthorized disclosure of which would cause exceptionally grave damage to the nation.

Secret is information and material (matter), the unauthorized disclosure of which would endanger national security, cause serious injury to the interests or prestige of the nation, or would be of great advantage to a foreign nation.

Confidential is information and material (matter), the unauthorized disclosure of which would be prejudicial to the interests or prestige of the Nation or would cause unwarranted injury to an individual, or be of advantage to a foreign nation.

Restricted is information and material (matter) which requires security protection, other than that determined to be top secret, secret, or confidential.

Unclassified matter is information or material of such nature that its disclosure could not endanger public interest or the interests of the service. It does not, therefore, require safeguarding to prevent unauthorized circulation.

Identification symbols, which include the originator's code and may include a file number, or a serial number, or both, are used on correspondence for reference and record purposes.

An originator's code is a system of letters, or numbers, or both, used for the sake of brevity to indicate the organizational unit of the activity preparing the correspondence.

A file number, usually in the form of a letter-number symbol, is a system of letters and numbers used for the sake of brevity to represent a subject or name under which the material is to be filed.

A serial number is one of a consecutive group of Arabic numerals assigned to a specific piece of correspondence for identification purposes.

A reference is a brief citation of material which relates to the subject matter of the correspondence.

An enclosure is material forwarded with the correspondence or forwarded separately, if so indicated.

The filing system is designed to meet the filing needs of the Naval Establishment, and it provides a convenient classification plan for the arrangement of subjects found in general correspondence files. It reflects the functions of the Navy and permits ready access to all information concerning an activity. All filing systems should be established as directed by the current filing manual.

Mail recording.—It should not be necessary to record all incoming and outgoing mail. The commanding officer should define the types of mail to be recorded, such as that pertaining to policy, funds, organization, and congressional inquiries. This will serve as a guide so that only the more important mail rather than routine mail will be recorded and controlled. Necessary records should be maintained for the receipt and handling of classified material and remittances.

Mail routing.—Incoming mail should be promptly routed to the action desk, and records should be kept to assure prompt and complete action when required.

Classified matter.—The handling and filing of classified matter should be carried out in accordance with the United States Navy Security Manual for Classified Matter.

Preservation and disposition.—All records accumulated and filed by an activity are the property of the United States Government and cannot be disposed of except as provided for by law and Navy regulations. Responsibility for the disposal of records rests with the Secretary of the Navy. Detailed instructions regarding the management and disposition of records may be obtained from the district records management officers or the Manual of the Medical Department.

Reports and records.—All naval activities are required to maintain records and submit certain special and periodic reports as specified by Navy departments and other competent authority. These reports and records are required for the evaluation of medical and administrative practices, future reference and planning, and compilation of statistical data. State and Federal laws require medical activities to keep certain records in case of criminal acts and for the protection of public health. Information as to requirements in medical reports and records may be found in the Manual of the Medical Department and current directives.

PERSONNEL—RECORDS MANAGEMENT

The proper keeping and safeguarding of the health record is one of the most important responsibilities of the hospital corpsman. This responsibility begins with the hospital apprentice in the wards, and increases in importance with advancement in rating and responsibility. An entry of a minor treatment at sick call made on the NavMed 10, which becomes a part of the health record, may seem trivial and unimportant at the time, yet years later may be the basis for an allowance or rejection of a claim for compensation. A health record properly maintained, all entries made as necessary, may save many hours of work on the part of a medical officer, and a great deal of expense to the government at a later date, not to mention the inconvenience and possible suffering on the part of the individual concerned.

The health record is a continuous record of the individual's physical history from the date of entry into the service until the date of termination of service. It is permanent, and upon termination it is forwarded for permanent filing. All entries are permanent, and only another entry can cancel one previously made by error—it cannot be eliminated. Too great an emphasis cannot be placed upon the importance of this record, and the correct entries being made therein.

Certain entries are required in all health records, and only certain abbreviations are authorized. The record contains the report of physical examinations, both medical and dental, upon entry into the service. A record of immunizations, and inoculations is maintained on a page provided for this purpose. It must be kept current, all types of immunizations and "booster" injections being recorded immediately.

Space is provided for service history, giving the date of attachment and detachment from each ship and station. Additional space is provided

for a résumé of medical history, giving the dates of admission and disposal from the sicklist, the diagnosis, and other pertinent data. Special sheets are provided for luetic history and for complete medical history entries. The record is in loose-leaf form, permitting the insertion of additional pages as required. For complete information on the health record, the various authorized abbreviations, entries required, and the proper method of handling the health record, reference should be made to the Manual of the Medical Department, Bulletin of Bureau of Medicine and Surgery Instructions, Notices, and other current directives.

Certain information is required by the Bureau for the evaluation of medical and administrative practices, future reference and planning, compilation of statistical data, and to comply with certain laws. To obtain this information, certain records are required to be maintained and certain reports submitted either periodically or as required. Information as to requirements in medical reports and records may be found in the Manual of the Medical Department and other current directives.

Personnel Management is one of the major factors in the naval service and one of the most important personnel records is the service record. The hospital corpsman must realize that this record is a permanent record, and upon termination of service it is permanently filed. All entries therein are permanent, cannot be deleted, but can only be canceled by another entry. Too much emphasis cannot be placed on the proper care and safeguarding of this record, and the proper entries being made therein. The record is in loose-leaf form, permitting the insertion of additional sheets as may be required. Certain pages are designated for certain information. The service record must accompany the individual when transferred. The Bureau of Naval Personnel Manual and other current directives give complete information on the service record, the entries to be made therein, and the proper methods for safeguarding and transporting the service record.

DEATHS AND MEDICOLEGAL MATTERS

Silence

The first rule of conduct for the hospital corpsman is to maintain a close guard upon his words and his actions. If he thinks twice before he speaks and then speaks not at all, he often will have cause to congratulate himself upon his good judgment.

The young man just entering upon a career in the Hospital Corps should try to acquire the habit as soon as possible. Information can be imparted intentionally or unintentionally by an appearance of excitement or a shrug of the shoulders as clearly as by voice.

This does not mean that matters are not to be discussed with persons who should know them, but it does mean that idle gossip is to be avoided. The senior hospital corpsman and the medical officer are entitled to a knowledge of everything pertaining to the medical department that comes to the attention of the junior hospital corpsman, and all problems should be taken to them. Whether the information should go farther is a matter to be left to the judgment of the medical officer. The hospital corpsman acting alone is responsible to the person in charge.

The very foundation of a successful medical department is based upon confidence. Those who care for the sick and injured often have glimpses into the innermost thoughts and habits of patients that are denied to others, and it is only under such conditions that they can be properly ministered unto. A patient should know that he can confide in those caring for him, feeling that what he says or does will reach only those who are to help him.

Hospital corpsmen also must be close-mouthed about things other than patients. Extend the habit to cover all the activities of the medical department. This is not for the reason that they are so secret, but because the person to whom one talks probably will not understand fully. He has not been trained medically and is not qualified to pass judgment, and he has merely been provided with something upon which the imagination can work. This applies not only to sanitary measures or ordinary occurrences, but particularly to accidents, to deaths from other than natural causes, or other peculiar situations. The medical officer bears the responsibility and it is for him to handle the situation.

The hospital corpsman, by reason of his duties, comes intimately in contact with situations that may afford rich material for gossip. Operations, deaths, autopsies—all, in time, may become largely

matters of routine to him, but to others, they are unusual, and their details serve to gratify a morbid curiosity. The talkative hospital corpsman is always certain of a large and attentive audience. His story soon becomes entirely distorted and it is passed along. But the matter does not end there. He has betrayed a confidence and loses in large measure the respect of his fellows. The distortion of his tale may bring his department into disrepute. His value as a witness is lessened, for he may have said something in his enthusiasm as a story-teller that he would not feel justified in repeating under oath. He may have handicapped the investigation of some criminal act and thereby caused much inconvenience to the course of justice.

Both by words and bearing, a hospital corpsman must always strive to create confidence in the efficiency of the medical department. He should make others feel that there they will find competent treatment for their ills and solution of their sanitary problems. No matter whether things are going right or wrong, a hospital corpsman should be calm, close-lipped, cheerful, and efficient. He should live up to the best traditions of the Hospital Corps.

Personal Property

The duties of the hospital corpsman often make him responsible for the property of others, and he will save himself and others much trouble by being very careful. Few things cause as much worry and ill-feeling as an accusation by a patient or next of kin that some possession has been lost or stolen.

The original inventory of personal effects which accompanies all patients upon transfer is very important, as it is the very basis of the transaction; and also because the patient may not see all of his property again for days or months. When he does take charge of them again, there must be no question as to whether the list is correct. Prepare it carefully, and actually see every item that is entered. Do not simply ask the patient what he has and put down what he says.

In the ward, the patient often keeps certain valuables with him, such as a watch, jewelry, small change, books, and other similar items. He should be advised to place them in safe keeping, calling his attention to hospital orders to this effect, otherwise the hospital is not responsible. If the patient insists on retaining certain items on his person, then these items should be inventoried, listed on a separate sheet of paper and this sheet retained on the patient's chart until his discharge from the hospital.

Often there is occasion to take charge of personal property, including valuables. This occurs upon death, or when a corpse is found, or when a patient for some reason can no longer guard his property. Ordinarily it should be done immediately, for valuables have a curious habit of soon disappearing. Do not wait an hour or so, but see that the property is placed as soon as possible under the care of the proper person. (See Manual of the Medical Department, U. S. Navy.)

Dispensing

Matters of life and death are always under the hand of the hospital corpsman. This will be novel at first, but soon it becomes familiar and tends to be mere routine; and the hospital corpsman must closely guard himself against the development of such an attitude. He is surrounded by death-dealing agents and uses them constantly, and the mistake that results in death or serious illness is not merely a sad occurrence; it makes him criminally responsible.

Every endeavor is made to supply all reasonable means of avoiding mistakes in the dispensing of drugs and the use of poisons. The regulations specify that the dangerous ones shall be placed in special bottles or kept under lock and key so that there may be no mistake. The poison bottle can be recognized easily. Failure to detect the poison bottle can be due only to gross carelessness.

Hold drugs and chemicals in deep respect, and cultivate, at the outset, the habits of care and precision. Be sure to be wide awake when using them. Inspect the container, read the label, and be certain that it is the one specified by the prescription or by instructions. Settle any doubt by inquiry of the proper person. Label the containers promptly, and never think that the nature of the contents can be guessed when there is no label. Never do any guessing.

One of the greatest sources of trouble is the care of alcohol and narcotics. It is in their care and use that hospital corpsmen are particularly liable to the penalties of the law. The Manual of the Medical Department, U. S. Navy, discusses this

subject, and the hospital corpsman must be thoroughly familiar with it. United States Navy Regulations also refers to it.

The Insane

Another situation in which the hospital corpsman shoulders great responsibility is in the care of the insane. The very nature of his calling, naturally, will insure the best of care for the patient. But the problem goes deeper. It must be realized that an insane person is not responsible for his acts. He is a sick man, and he does not think in all things in the same manner as those who are well. It is the duty of those caring for the insane to protect others who may come in contact with him, and also to guard him against himself.

Usually there is some person who has the responsibility for the welfare of the patient, and the instructions for his care will be definite and complete. But it is the duty of hospital corpsmen to use their common sense to the utmost. The person who is mentally unbalanced is extremely likely to injure himself seriously. Keep him under constant observation. Remove articles that are dangerous. Do not take any chances.

A hospital corpsman may have to guard an insane patient while traveling, or while he takes exercise on the deck of a ship, or in the grounds of an institution. Then one must be trebly careful for he may attack others, or try to escape, or attempt to commit suicide. It will happen unexpectedly and most suddenly, and he may avail himself successfully of some opportunity that failed to be considered or did not appear to be of importance.

Dying Declarations

A hospital corpsman may happen sometime to be the one to whom a person at death's door makes a statement of importance; that is, a dying declaration, or ante-mortem statement. It may have to do with matters of money, property, or some criminal incident. Under any circumstances it is an expression of the thoughts and desires of a dying person. In it may lie the clue to the solution of some problem of crime. Therefore exercise every care to understand it correctly and fully.

To have full weight in law, however, and to be admissible as evidence before a court, the dying declaration must be made and recorded under certain definite conditions. Real responsibilities are assumed when circumstances compel one to receive such statements. And it is a duty to know how to insure that they be of legal value, and to make them so.

The person making the statement must be convinced that his death is soon to occur—he must have no expectation or hope of recovery. The person receiving the statement must assure himself that this is his attitude, and also, to the best of his ability, as to whether his mind is clear and rational. Then explain to him the importance of the statement he is about to make.

The statement must be voluntary; that is, not forced. Write it in his own words as he makes it, and be very careful not to include anything he does not say. Never put down what it may seem he should have said. If it can be done, have the person swear to his words before proper authority.

A declaration made thus will be of value in the eyes of the law, but do not hesitate to take any such declaration under any circumstances. Take it in writing, and remember which of these conditions has or has not been fulfilled. If possible have two witnesses present, and have them sign the statment in the presence of the individual and each other.

Deaths From Unnatural Causes

The first rule of conduct when one finds the remains of a person who apparently has met his death from violence or other unnatural causes is to avoid any disturbance of the body or of objects in the vicinity. Make certain that the person really is dead, and then see to it that nothing is disturbed until those in authority so direct. Avoid unnecessary handling of objects about the corpse, especially such as may bear fingerprints.

The only reasonable excuse for disturbing anything will be to ascertain whether or not the person is dead. And, before doing so, a clear mental picture of the condition and position of the body before disturbance must be formed. Meanwhile be sure to notify the medical officer or other person in authority. If no messenger is available and the remains must be left alone, endeavor to prevent possible tampering by others by locking the remains in a room if possible.

A hospital corpsman probably will arrive at the scene early, and he must try to make himself

a useful witness. Imprint clearly upon the memory the position and condition of the body and of objects in its vicinity. Prepare a record of the results of the inspection at the earliest possible moment. Memory is treacherous, and later one may be very thankful for such notes.

Previous remarks relative to valuables apply here also. Make an inventory of those that are visible so that it can be referred to if the question arises later as to whether something has been lost or stolen.

Habits of silence will be of particular importance in connection with unnatural deaths. Beyond its value in general one must anticipate a probable call to the witness stand. One's knowledge should be clear in the memory, as well as clearly stated in the notes. If the matter is discussed with unauthorized persons, all sorts of suggestions and comments will be heard, and, unconsciously the opinions of others may be permitted to replace one's own. The court is not interested in this hearsay evidence—the thoughts of other persons. It desires what one knows of his own knowledge, and therefore strive to preserve that intact and clear-cut.

Identification of the Dead

This problem usually will fall to the lot of persons other than the hospital corpsman. Still, he may find himself so situated that he must give an opinion, and he should be familiar with the means that may be employed.

The records kept in the naval service are usually very complete as to the physical characteristics of each individual. There are the health record, the service record, and the fingerprints. The portion of the health record that is devoted to the teeth is of great importance.

There is also the identification tag. But even the finding of such a tag with the body must not be considered conclusive evidence of identity. The characteristics listed in the before-mentioned records of the individual specified by the tag must check with those of the corpse before identification can be considered as established. A fingerprint also must be made.

The procedure to be followed involves a careful examination of the body for the points recorded. Not only must marks, moles, and scars be considered but also external measurements, color of hair and of eyes, deformities, and other possible means of identification. It is especially important to compare the teeth closely with the description in the dental record.

It is surprising how obscure scars, moles, freckles, and birthmarks can become after death, even when decomposition has not occurred. The latter, of course, adds to the difficulty. The search must be very carefully made, and it is all-important to have a good light. It is for this reason that the dental record is of such able assistance. The peculiarities of the teeth are very reliable and permanent.

The fingerprints will settle any doubt. The epidermis is very resistant to decomposition. As long as it is present, it will be rare that serviceable prints cannot be secured if proper care is exercised. Even when the skin is shriveled, good results usually can be obtained by carefully following the directions given in the Manual of the Medical Department, U. S. Navy, or subsequent instructions that may come from the Bureau of Medicine and Surgery.

Occasionally, the remains consist only of a number of bones. The teeth will help in such a case. Otherwise, the identification will be beyond the ability of the hospital corpsman. If other aid cannot be secured, his problem will be to determine how many bodies are represented by the bones. This is not so difficult if many bones are present. Look for duplicate bones, but remember that there are two sides to the body.

TRAINING FACILITIES IN THE NAVY

Training facilities in the Navy fall into five main groups: recruit, service school, shipboard, educational services, and fleet schools. Each group deals with problems peculiar to its own situation, although in the final analysis the basic objectives are much the same. These groups will be discussed briefly as follows:

Recruit Training

The basic training of the recruit is concerned with transforming a civilian into a potential member of the Navy team. In the space of a few short weeks, usually from 8 to 14, the recruit learns primarily to adapt himself to life in a line organization—a concept that is foreign to his back-

ground and experience. Guidance and indoctrination introduce him to the manners, practices, discipline, and customs of Navy life. Toward the end of this training the recruit is interviewed and classified according to abilities and aptitudes as indicated by tests and performance in training.

Service School Training

There are four classes of service schools, graded with respect to the difficulty of the technical material taught. They are classified as P, A, B, and C. These schools are charged with establishing and maintaining a curriculum to instruct men in the duties and skills required for responsible jobs in the operation forces. One of the requirements for many chief petty officer ratings is that the candidate must have successfully completed a course of study in his specialty in one of the class A or B service schools. Quotas for class A service schools are filled in the proportion of 50 to 60 percent from the fleet.

Shipboard Training

The officer directly responsible for the training program aboard ship is the executive officer, under the authority of the commanding officer. The executive officer is charged with organizing, coordinating, and controlling the training function. Each ship has its own particular training program, with its organization and responsibilities drawn up in what is known as a training bill. The training bill delineates the need, the objectives, the duties, the responsibilities, and the authorities; and it also includes a statement of policy. It is the duty of each department head to determine just what training is most needed and will be the most beneficial for his personnel. Perhaps the greatest advantage to training aboard ship is that such training is conducted in the situation in which it is to be used. All the necessary equipment and material are at hand because the set-up is real.

Educational Services

The educational services provided for naval personnel are concerned with advancing the general education of the individual man. While his technical and job training are progressing, his educational background and the advancing of his formal schooling are still of interest to the Navy. Every effort must be made to provide information and opportunities for the man to enroll in some program of his own choice, which will further his own knowledge and his usefulness to the service.

Almost any field of study is available under the educational services. Often classes are organized aboard ship or on shore stations; instructors are appointed who have had training and experience in fields of particular interest to the men enrolled. Sometimes civilian instructors are hired to teach subjects for which a demand exists. Another phase of the educational services is the program of individual study through the medium of correspondence courses available through the United States Armed Forces Institute. This institute is an official agency of the Army and Navy departments, and the Armed Forces provides services and material for study to service personnel at a minimum cost. In addition to these study courses, extension courses are offered by a number of civilian colleges and universities operating in conjunction with the institute. In this way higher education from an accredited institution of learning is available to every man in the Navy. The varied and extensive opportunities offered by the educational services mean that any Navy man can study a subject of his own choice under excellent guidance very inexpensively. The only vital requirements are interest and determination to pursue the course to its successful completion.

Some state education departments will issue high school diplomas upon reporting satisfactory completion of the United States Armed Forces Institute general educational development tests (high-school level). For in-service purposes, two years of college work may be earned by successful completion of the United States Armed Forces Institute general educational development tests (first year college level, and 2CX).

FINANCE

Allotments

The Bureau is charged with the responsibility for the administration of appropriations under its cognizance.

An appropriation is an authorization by an Act of Congress to make payments out of the Treasury for specified purposes.

An allotment is an authorization by the head of an agency to incur obligations within a speci-

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fied amount pursuant to an appropriation or other statutory provision.

Obligations consist of orders placed, contracts awarded, services received, and similar transactions during a given period requiring future payment of money.

Authority for obligation of funds is usually granted by allotment. No obligation shall be incurred against any appropriation unless sufficient funds are available under an allotment, granted for the purpose, except in emergency as authorized by Navy Regulations or the Manual of the Medical Department.

Allotments are granted to cover sums approved by the Bureau in the activity's annual estimate of expenditure. The approved annual estimate of expenditures then becomes the basic financial plan of the activity for the fiscal year.

In the event it becomes necessary in emergencies to obligate funds in excess of an existing allotment, or in the absence of an allotment, a report of the circumstances, accompanied by a request for allotment, shall be forwarded to the Bureau by letter or dispatch.

Certain ships and shore stations, not specifically directed to submit annual estimates of expenditures, are granted annual allotments without request.

Certain ships and shore stations are authorized to incur obligations against allotments maintained in the Bureau. Annually, the Bureau promulgates instructions concerning such authorizations. These instructions establish monetary limitations, and direct the manner in which the activity receiving such authorization will report expenditures and obligations.

The allotment authorization forwarded to the activity indicates the program allotment number, the appropriation, the administrative subhead, the purpose, the quarterly or other apportionment, and the total sum granted.

The total amount allotted by the program, as indicated by the allotment authorization, shall not be exceeded without prior Bureau approval, except as provided for in Navy Regulations.

Requests for modifications of allotments shall be submitted as soon as practicable after the need therefor becomes apparent. Requests shall, except in cases of immediate urgency, be submitted by letter, furnishing a detailed statement of justification and outlining the specific circumstances necessitating the request.

In case of emergency, a dispatch, confirmed by letter, may be used to request modification of allotment, using the following form:

Request allotment number (______) be increased (state amount) (______) Quarter, Fiscal year (______) X Increase required due to (state briefly circumstances).

In case of emergency in which delay would endanger human life or Government property, the commandant or senior officer present may authorize purchase or work be started. In each instance, forward request to the Bureau as soon as practicable, making reference to the authorization of the commandant or senior officer present.

Object classification of allotment obligations and expenditures is required by the Bureau of the Budget and is based upon the nature of the services, articles, or other items involved, as distinguished from the purposes for which such obligations and expenditures are made.

Object classes and their two-digit numerical codes have been prescribed and are listed in the Manual of the Medical Department. The third digit of the object classification denotes the subdivision of the prescribed object class required by the Department of the Navy. The fourth digit of the object classification denotes the subdivision of the prescribed object class required by the Bureau. They are listed in current Bureau instructions.

Records, reports, and report of allotment expenditures are required by the Bureau for the purposes of compiling reports to other governmental agencies and higher echelons, and for future estimating and budgetary requirements. These records shall be maintained and required reports submitted in accordance with the Manual of the Medical Department and other current directives. The Bureau of Medicine and Surgey Instructions should be especially consulted.

Allotments are granted to ships and stations for the purpose of procuring nonstandard items of medical and dental materials, special diets, and other sundry items required for the care of the sick and injured which are not obtainable from the Medical Supply System. Costs of laundry and maintenance services at ships and stations is not chargeable to Medical Department allotments.

Medical and Dental property accountability for vessels shall be maintained on board in the manner prescribed in current directives. For information to be submitted in financial reports, refer to Bureau Instructions and other current directives.

Procurement

It is a responsibility of all cognizant personnel to keep property acquisitions consistent with the requirements of the mission and functions of the activity, to avoid overstocking of materials, and to insure economical administration of public funds, services, and materials. This responsibility is applicable to hospital corpsmen, as well as to department heads, especially those hospital corpsmen on independent duty.

Materials and services required for the maintenance and operation of medical and dental activities of the Navy including material and services chargeable to Bureau of Medicine and Surgery allotments, and those materials and services chargeable to the appropriations of other bureaus of the Department of the Navy are usually obtained by the following means:

(*a*) BuMed Material Requisition (NavMed–4).

(*b*) Purchase Requisition (Nav S and A Form 44 afloat, or Nav S and A Form 76 ashore).

(*c*) Stub Requisition (Nav S and A Form 129).

(*d*) Receipt/Expenditures Invoice (Nav S and A Form 127).

(*e*) Request for Performance of Work (Nav S and A Form 140).

(*f*) Letter requests.

(*g*) Nav MC–24 QM, Invoice and Receipt; and Nav MC–33–SD, Shipping Order, Invoice and Receipt, Marine Corps.

BuMed Material Requisition (NavMed–4)

Standardized procedures for requisitioning medical and dental material from elements of the Medical Supply System have been established in order that the Bureau may abstract statistic and logistic data as to usage, stock levels, and reserve quantities. All items in the Armed Services Catalog of Medical Material listed as being available to the Navy shall, except in emergency, be obtained from medical supply facilities on BuMed Material Requisition (NavMed–4). Items listed in the Armed Services Catalog of Medical Material shall not be purchased locally, except when the need is immediate and will not permit delay incident to procurement from a naval medical supply facility or by transfer from another naval activity. In emergency or when otherwise indicated, medical and dental items may be requested from naval medical supply facilities by messenger, telephone, dispatch, or letter request. Requisitions from ships for items that are in excess of current stock levels based on approved ships' allowance list shall be justified and submitted via official channels to the naval medical supply facility.

Purchase Requisition (Nav SandA 76 and 44)

Materials not listed in the catalog of naval material or carried in stock at naval medical supply facilities or by a supply officer or a marine corps installation may be obtained by purchase requisition procedure.

For complete information on this form and methods of preparation, reference should be made to volume II, Bureau of Supplies and Accounts Manual, current Bureau instructions and the Manual of the Medical Department.

Stub Requisition (Nav SandA Form 129)

Material listed in the General Stores Section of the Catalog of Naval Material may be obtained on stub requisition. Material issued on stub requisition is chargeable to the program allotment indicated on the stub requisition. Detailed instructions for preparation of stub requisition is contained in volume II, Bureau of Supplies and Accounts Manual.

For details on procurement methods (*d*), (*e*), (*f*), and (*g*), reference should be made to the Manual of the Medical Department and other current directives.

Approved requisitions (annual purchase, individual purchase, and annual) are not to be considered as authority for a field activity to obligate funds in excess of the amounts made by allotments, unless such materials or services are required in emergency.

Materials and services required for the maintenance and operation of Medical Department activities, which are chargeable to an appropriation under the cognizance of the Bureau of Medicine

and Surgery, may be procured only when funds are available for the purpose under a specific allotment granted to the activity by the Bureau, except for the following:

1. Material obtained from naval supply facilities.
2. Material obtained from other Medical Department activities.
3. Procurement specifically designated by the Bureau as a charge to an allotment maintained in the Bureau.
4. Local emergency purchase of medicines and of civilian medical, dental, nursing, ambulance and hospital services as authorized in the Manual of the Medical Department.
5. Medical Department material or services for certain ships and certain stations to which no allotments are made.

Medicines, and civilian medical, dental, nursing, ambulance, or hospital services, for persons in the naval service, as defined in article 1208, Navy Regulations, may be procured without requisition or allotment but such procurement shall be subject to instructions contained in the Manual of the Medical Department.

Certain nontechnical materials and services required for the maintenance and operation of medical and dental activities are under the control of other bureaus and offices. Procurement procedures for such items are contained in the Bureau of Supplies and Accounts Manual.

Standard commissioning allowances for ships and initial outfitting allowances for advance base components will be issued when required without prior action on the part of the medical or dental departments of the ship or unit.

Basic outfitting of Fleet Marine Force Organizations will be governed by the allowances and procedures set forth in the Fleet Marine Force, Medical and Dental Logistic Support Pamphlet published by the Chief of the Bureau of Medicine and Surgery.

The commanding officer of continental activities shall submit requisitions for commissioning allowance materials, except in certain instances wherein the Bureau will signify intention to automatically supply commissioning allowances. Continental activities may request commissioning allowance lists from the Bureau to be used as a guide in preparing requisitions.

Certain types of small vessels not holding Medical Department allotments, and whose requirements for nonstandard medical items are rare, may procure these nonstandard items by applying to the nearest shore station or base regularly supplying vessels of the same type; any shore station or base; medical supply depots; or other ships. A letter request may be used for this purpose.

Accounting—Ships and Shore Stations

In order to avoid unnecessary expenditures of public funds and stores and to comply with laws, regulations, and instructions governing the care and preservation of Government property, accurate and current records of property under the cognizance of the Medical Department shall be kept.

The accounting system for shore stations, other than naval hospitals, and for ships consists principally of records of acquisitions and dispositions of materials and services and of records of appropriation expenditures and obligations.

The journal of receipts and expenditures of Medical Department property is the book of original entry used to record data relative to each financial transaction involving the acquisition and disposition of property. Each entry should be substantiated by a duly authenticated voucher. Printed forms for the Journal of Receipts and Expenditures may be obtained from district printing and publication offices. There are four sheets for the journal:

Equipment section	Receipts.
Equipment section	Expenditures.
Supplies section	Receipts.
Supplies section	Expenditures.

The journal shall be closed at the end of each quarter and upon decommissioning by totaling each column and entering these totals on the appropriate line of the Statement of Receipts and Expenditures of Medical Department Property (NavMed–E).

Shore stations shall prepare and submit the Statement of Receipts and Expenditures of Medical Department Property (NavMed–E). Ships are not required to submit this statement, but in order to verify the value of materials remaining on hand, NavMed–E should be prepared in rough and retained in the files of the ship. For full details of accounting procedures, and submission

of reports and forms reference should be made to the Manual of the Medical Department, Bureau of Medicine and Surgery, Instructions, and other current directives.

There are a number of ledger forms, each used for a different purpose. Usually in these ledgers a separate sheet is maintained for each item of supplies or equipment. It is necessary that all data required be entered thereon. Refer to the Manual of the Medical Department and current directives for full information on the proper entries and methods of entry on these forms.

Invoices are dealers' bills from open purchase transactions. When supplies are shipped from a medical supply depot an invoice is sent with the shipment, giving the number of each item shipped, the unit cost of each item and total cost. This is used as the supporting voucher for entry into the journal and ledgers.

Vouchers are approved forms used to support entries in the books of account. Among many are:

Public voucher (Standard Form 1034).—Used in making payments for materials and services other than personal.

Transfer voucher received.—Invoices for materials and services received at no allotment charge. This is generally on Form S and A 127, and is usually referred to as a "TVR."

Transfer voucher issued.—Invoices for materials and services transferred to another activity at no allotment charge. This is generally on S and A Form 127, and is usually referred to as a "TVI."

Inventory adjustment voucher.—Worksheet with voucher listing items of supplies requiring adjustment through discrepancies between ledger balances and amounts actually on hand.

Issue voucher.—Individual NavMed "1342" authorizing issue of supplies to use.

Issue voucher.—Individual NavMedForm "11" authorizing issue of equipment for use or for return to store.

The invoices and vouchers listed above are the more common ones used in substantiating entries in the books of account. No entry should ever be made in the journal or ledgers without a supporting voucher to substantiate that entry.

Property Management

Property is the term applied to lands, buildings and improvements, equipment, and supplies, which are purchased for, or donated to the Naval Establishment.

The Bureau establishes basic policies governing naval medical material and is responsible for the direction and coordination of all elements of the Medical Supply System. It determines the requirements of medical and dental materials used in the Naval Establishment, and has control of the preparation of specifications for, and the procurement, inspection, receipt, storage, care, custody, and issue of such materials.

Property under the cognizance of the Bureau is classified into four major groups: (1) land; (2) building and improvements; (3) equipment; (4) supplies. For complete explanation of these various categories reference should be made to the Manual of the Medical Department.

For the purpose of this chapter, equipment may be considered as such if:

1. It is so designated in the Armed Services Catalog of Medical Matériel;
2. If it is carried in the plant account of a naval hospital;
3. If the item has an expected normal useful life of 1 year or more; a unit cost of approximately $50 or more; and it is used to facilitate and expedite the performance of the assigned function of the activity but not consumed, unduly altered, nor materially reduced in value by use.

Supplies may be defined roughly as articles for consumption; that is, property which is ordinarily consumed or expended within a comparatively short period of time; is converted in the process of construction, manufacture or use, or is a replacement part for fixed or other equipment.

The commanding officer, or officer in charge of each activity under the management and technical control of the Bureau; the medical, dental, medical service corps officers, or the Medical Department representative, as appropriate, of each ship or station shall be responsible for all Bureau cognizant property under his control.

All persons having custody of property under the cognizance of the Bureau shall avoid any unnecessary expenditure of property insofar as it may be within their power to do so, and they shall

prevent the same in others. All such persons shall be held responsible for any wasteful or improper expenditure or unauthorized use of any property that they may direct, authorize, or knowingly condone.

Approved records and forms shall be maintained at all medical and dental activities. Reference should be made to the Manual of the Medical Department and other current directives.

Equipment.—These items are issued on custody (NavMed Form 11). They are placed in each department, and shall not be moved from one department to another, or from one ward to another, without proper approval. This approval is on an approved form, in writing, usually the NavMed Form 11, or approved local form. No item of equipment can be disposed of without an approved survey of property, transfer of property, or as directed by competent authority. Every move of an item of equipment must have an approved voucher to substantiate that move. The hospital corpsman cannot be too cautious in his approach to the handling of equipment.

Supplies.—Items can only be issued from the storerooms for use on an approved voucher, usually NavMed Form 1342. Supplies must be economically expended and used.

The Armed Services Catalog of Medical Matériel list certain precautions in the handling, care and use of certain items of supplies. Regulations have been established for the custody, issue and accounting of alcohol, narcotics, poisons, and allied materials.

Certain biologicals require special storage, as yellow fever vaccine; other types may not be frozen. Practically all biologicals have potency dates established. That date is usually stamped on all containers. These should be checked frequently.

Highly flammable materials such as ether, acetone, and ethyl chloride, require special storage facilities to aid in preventing fires, and ease of disposal in case of fire aboard ship.

Corrosive acids such as nitric, hydrochloric, and sulfuric should be stored in special lead-lined containers.

Items made of rubber, such as rubber tubing, gloves, and ice bags, should receive special attention. Items of this nature, if kept stored in storerooms with high temperatures, deteriorate very rapidly.

There are drugs other than biologicals which have potency dates established. These should be observed carefully.

Care should be exercised in the handling of supplies. Many containers are easily broken, causing not only the loss of the contents, but may ruin other supplies stored nearby.

Supplies should be rotated, the rule governing this is "oldest stock used first."

Chapter XVII

INDEPENDENT DUTY

There are numerous small ships and stations in operation without the services of a medical officer. This necessitates the assignment of a hospital corpsman, usually a chief or first class, to be the Medical Department representative of the activity. The hospital corpsman is not offered as a substitute for a medical officer but rather as a first-aid man.

There are many types of vessels and small shore stations to which the hospital corpsman may be detailed. This includes many surface vessels, submarines, and various small craft. It may be a small isolated station ashore in the Tropics or in the Arctic regions. Each type duty will have its own peculiar conditions and special requirements. Every chief and first class hospital corpsman must be prepared at all times to immediately assume the responsibilities of this type duty.

It is the corpsman's responsibility to make recommendations to the executive officer and commanding officer regarding all matters which may affect the health of the crew, or the efficient operation of the Medical Department.

When reporting on board a ship or small station for independent duty, one of the first objectives should be to ascertain the policies of the commanding officer. This can usually be obtained from the executive officer. Make every effort to carry out the policy.

When reporting, the following should be accomplished immediately:

If reporting on board a ship or station just going into commission, obtain the Medical Department commissioning allowance list. This will usually be available before the shipment of supplies and equipment is received.

If relieving another corpsman, the following should be done immediately:

Inventory of Medical Department and title B property. Do not sign a transfer of property or a custody receipt without making note of any missing item, or items that are in need of property survey. Report these to the commanding officer in writing.

Inventory narcotics, alcohol, and poisons. The amounts on hand must agree with the ledger and narcotic log. Any discrepancies must be reported to the commanding officer at once. Comply with article 3-36 Manual Medical Department, and article 194, Treasury Department, Bureau of Narcotics Regulation No. 5, 1 April 1949.

If time permits, check supplies against amounts shown in supply ledger before signing receipt.

The following should be checked as soon as practicable and kept up to date:

Supplies and **equipment** ledgers checked against receipts and expenditures and last reports submitted.

Narcotic, alcohol, and prescription logs.

Receipt and expenditure journal.

Health records.—Pay particular attention to: Missing records, check against ship's roster; missing abstracts; luetic histories; immunizations; routine chest X-rays; annual physical examinations for officers. Request any missing records from former ship or station. Missing abstracts may have to be requested from Bureau of Medicine and Surgery. If all records and abstracts cannot be obtained within a reasonable length of time, new ones should be made. This will require examinations by both medical and dental officers.

Refer all luetic cases to the division or the nearest medical officer for determination as to requirements for further tests and treatment.

After initial check on health records examine each one carefully as it is received on board. Forward records promptly when personnel are transferred or discharged. Maintaining health records in a current up-to-date status is exceedingly important, both for the individual concerned and for the protection of the U. S. Government.

Logs

The following logs should be maintained:

Rough log.—All entries concerning the Medical Department of a generalized nature.

File of NavMed H-10.

Prophylaxis log.

Training log.

Receipt and disposition log for health records.

Immunization record log.

Narcotic, alcohol, and prescription logs.

Surgical operations log for preparation of NavMed Form P.

Files

Check for tickler files of reports. Make one if not maintained, showing forwarding dates on all reports submitted.

Be certain that all previous reports required have been submitted.

Be certain that files comply with Navy Filing Manual Instructions and the Records Retirement Program.

Make certain that all of the information for the sanitary report is available.

Publications

The following publications should be on board:

Manual of the Medical Department.

Bureau of Medicine and Surgery Instructions and Notices. These publications must be kept current. Make changes as they are received. Study all changes and Instructions and Notices carefully. Keep well informed and current on all directives and changes.

Bureau of Medicine and Surgery news letters.

Armed Services Catalog of Medical Material.

Training Courses for Hospital Corps.

Hospital Corps Handbook.

Treatment of Chemical Warfare Casualties (NavMed P-1328).

Manual of Radiological Safety (NavMed P-1283).

Interviewers Aid for VD Control Investigation (NavMed P-1288).

Basic Diagnostic Nomenclature (NavMed P-1294).

Instructions Governing Individual Statistical Report of Patients (NavMed P-1313).

Manual of Naval Hygiene (NavMed P-126).

Control of Communicable Disease in Man (American Public Health Association 1950).

Battle Dressing Stations

Many of the divisions of the fleets have lists of material which should be stored in the battle dressing stations. Consult fleet, force, and division orders which may pertain to these stations. Consult the division and force medical officers for advice and opinions as to the contents and material to be stored.

The physical location of battle dressing stations should provide: Lighting systems, both normal and emergency; power sockets for sterilizers and water heaters; water, both from ship's system and emergency tanks; sufficient room for handling a number of casualties at one time; emergency toilet facilities; a place for working on casualties and a place to lay them when dressed.

The supplies and the amount of each to be stored depends to a great extent on the amount of space available and any directives in effect from higher echelons. The division or force medical officers will have certain items that they especially desire.

Safety Inspections

Routine inspections of first-aid kits, boat boxes, life-raft kits, decontamination kits, and gun bags should be held at least once each week, preferably twice. Certain days should be set for these inspections. Replace any items which may have been removed. These items are listed in the catalog of medical material. They may be ordered complete, or contents ordered separately to replenish supply.

Lectures

Schedule and conduct lectures in first aid, personal hygiene, and venereal disease control. These lectures should be held in conjunction with the regular training program of the ship or station. The time allotted for these lectures will be governed by this program. When giving these lectures be prepared on the subject. Study and review ahead of time. Prepare an outline and follow it. This is an excellent time for the practical training of stretcher bearers.

Ship Inspections

Inspection of ships compartments: This inspection should particularly include the berthing spaces, food-storage spaces, galley, mess hall, refrigeration spaces, vegetable storage and preparation rooms, and the scullery.

In berthing spaces pay particular attention to mattresses for evidence of bedbugs and other vermin. (See ch. VI, Preventive Medicine, for illustrations.) Roaches are frequently found due to edibles being kept in personal lockers. Note air condition, if blowers are working satisfactorily, and evidence of overcrowding. General cleanliness and good housekeeping should be maintained.

In commissary storerooms pay particular attention to storage of bulk items, especially those that may be open such as flour barrels, pickle barrels, and other large food containers. Look for evidence of roaches, other vermin, rats, and mice.

In the galley, cleanliness of ranges and other items of equipment. How is it cleaned? Is steel wool used in cleaning food containers such as coppers, kettles, baking pans? Are knives kept clean, especially where the blade is attached to the handle? Are open food containers maintained? Check methods of washing and sterilizing all pots, pans, and other utensils. Meat blocks should be in good condition at all times. Evidence of roaches or other vermin. General cleanliness should be noted.

In refrigerators, note cleanliness, methods of storing food, evidence of defrosting, temperature maintained, any evidence of food spoilage. Check to see if cooked meats, especially hams, are well cooled before being placed in refrigerator.

In vegetable preparation rooms, the same observations should be made as in the galley. Note odors and evidence of rotting vegetables. Pay particular attention to methods of storage of vegetables, and evidence of roaches.

Pay particular attention to methods of washing and sterilizing mess gear. See that the thermometers on dishwashing machines are working properly, that personnel know how to operate machines; and that instructions for operating machines are properly posted. See that thermostatic controls maintain temperatures properly.

In mess spaces, the mess tables should be clean, cracks free of grease. Look for evidence of roaches, storage of unauthorized articles and general cleanliness of the messing spaces.

For more detailed information on the upkeep and inspection of commissary spaces, see chapter VI, Preventive Medicine, and the Manual of Naval Hygiene, NavMed P-126.

In reporting adverse conditions which may affect the health of the crew, tact and diplomacy will be required. If the hospital corpsman on independent duty has demonstrated that he has real ability, knowledge, and can be depended upon he will, as a general rule, encounter very little difficulty in these problems.

Inspection of Food Handlers

It will be found that much can be accomplished if a routine is established whereby all personnel detailed to handle food in any capacity be directed to report for physical examination before assuming those duties. At this time they should be given instructions in personal hygiene and questioned closely concerning past medical history. The health record should be examined for past history of certain conditions, especially luetic and dysentery. If these conditions have existed, be certain that a medical officer gives consent before the individual is detailed as a food handler. All food handlers should be particularly warned about washing hands well before handling any food or food containers, and after using toilet facilities. It is imperative that good washing facilities be easily accessible and available at all times. The hospital corpsman should especially note this in inspections.

A weekly inspection of all food handlers should be held. This inspection must be conducted regularly and with care. The following should be observed and each individual questioned concerning them: Clean uniforms; daily bath and complete change of clothing; the fingernails should be short and clean; evidence of skin rashes and infections, especially on the hands, cuts and bruises; coughs and colds.

Immediately preceding or following the inspection is an excellent time for special instruction to food handlers. The factors listed for the inspection should be especially called to their attention, and in addition they should be cautioned to watch for these various signs, and especially cautioned time and again about washing the hands

and observing them for rashes, cuts, and infections.

Inspection of fresh provisions received on board. This is done upon receipt of provisions, and whenever necessary. See Manual of Naval Hygiene, and chapter XVI, Medical Department Administration, and study Federal specifications available on food inspection.

Medical Supplies

Insofar as the operation of the vessel will permit, establish routine dates for normal replenishment of medical supplies. Normally all ships with Medical Department personnel attached order supplies on NavMed Form 4 from the nearest Medical Supply Depot, except submarines. Submarines obtain supplies from the submarine base, or if in the vicinity of a Medical Supply Depot, from there in the usual manner. When sailing dates do not permit, or in emergency, supplies can be obtained from the nearest medical activity. This is on a TVR. All vessels can draw supplies in this manner. District craft and other small craft without a Medical Department representative draw all supplies from the dispensary to which the craft is attached for medical care.

Space permitting, supplies should be stored in more than one place. More vital items should be distributed in two or three places about the ship. These will require periodic rotation, using old supplies first, but will make available some items in case of destruction of the main supply.

Deaths

In case of death the Medical Department of the command to which the individual was attached is responsible for the preparation of the NavMed-N (Certificate of Death), termination of the health record, and submission of other Medical Department reports relative to the death. This includes dispatch notification to the Secretary of the Navy and the next of kin. The information required in the dispatch to the Secretary of the Navy and sample dispatches of notification to the next of kin are listed in the Manual of the Medical Department.

Care of the dead is one of the most delicate and difficult problems which can confront Medical Department personnel, especially the hospital corpsman on independent duty. If in the vicinity of a naval district, contact the district medical office for advice and help if necessary. If this is not possible contact any large naval medical activity. Study carefully the chapter in the Manual of the Medical Department concerning deaths, and other current directives.

The original and four legible copies of the NavMed-N are required by the Bureau in case of death of active-duty personnel. One is retained for the activity files. A print of the right index finger is required on each copy (if right index finger cannot be printed, use another finger and specify which one used. If all of the fingers give bad prints, then take prints of all fingers and thumbs on the back of the form. Specify which hand and finger). When making this print, it is advisable that at least two complete sets of the NavMed-N (six copies to a set) be made with the fingerprint. Study the instructions for the preparation of this form carefully in the Manual of the Medical Department.

All forms which may be required to be made in case of death are listed in the Manual. Study them carefully and prepare the ones which are applicable.

Routines

Routines should be established for:

Daily sick call.—Treatment of sick and injured. Maintain accurate records of all treatments (NavMed H–10 properly prepared).

Daily inspection of venereal disease prophylaxis station. Keep neat, orderly, labels clean, and all supplies in good condition. Be certain that instructions are legible and clear.

Surveys of equipment should be held once every 6 months, or whenever necessary in case of destruction or loss. S & A Form 154 is used. Generally the survey should be informal. Consult the Manual of the Medical Department and Supplies and Accounts Manual for detailed procedure.

Immunizations.—Arrangements should be made for all immunizations due at regular periods. The prospective movements of the vessel should be considered in this if possible.

Routine examinations and dental appointments should be arranged in advance if possible. A little forethought in these matters will prevent many emergencies later. An excellent time for

routine procedures, such as eye refractions, minor corrective surgical procedures and other routine examinations, is during the overhaul period of the vessel. Annual chest X-rays should be taken during this period if possible.

Quarantine.—All independent duty hospital corpsmen should be throughly familiar with Navy Department General Order No. 20, which is concerned with quarantine regulations for vessels and aircraft of the Armed Forces. This general order is used whenever a ship leaves the continental United States for any foreign port or territory and upon return to the United States. Information pertinent to the preparation and submission of reports, forms, and records is contained in the Manual of the Medical Department.

Submarine.—Duty on board submarines is essentially the same in many respects as other independent duty. Those detailed to this duty must be examined and found physically and mentally qualified in accordance with instructions contained in the Manual of the Medical Department. They are then sent to the submarine school at New London, Conn., for a course in submarine medicine technique. For the most part, the outline given above will apply to submarines. Additional necessary information will be given at the school. In case of emergency, there may be a few individuals transferred to submarines without the advantage of the submarine school. The above outline should be of benefit to those few individuals.

Shore patrol duty.—There are other types of duties which are similar to independent duty and at times may be considered as such. Shore patrol is one of these. There may or may not be a medical officer assigned, depending upon the location, distance from ship or station, and other local conditions. The primary duties of the hospital corpsman will be to establish a first-aid station and provide venereal disease prophylaxis.

Usually the large hospital corps pouch will suffice for first-aid material. Injuries sustained ashore that may require hospitalization should be given special attention. In a grave emergency the hospital corpsman should obtain verbal permission from the senior shore patrol officer to take the patient immediately to the nearest hospital. The great majority of cases may, after first-aid treatment, be returned to their ship or station. In addition to treatment the following information should be obtained if possible:

a. Was the man on authorized leave?

b. Was the man intoxicated?

c. Was the injury due to his own misconduct, negligence, or negligence of others?

d. A résumé of facts concerning the injury. Obtain names and addresses of any witnesses if possible.

The establishment of a venereal disease prophylaxis station will be governed by local conditions, size of liberty party, length of stay ashore, and will usually be determined by the senior medical officer.

Whatever type of independent duty the hospital corpsman may be assigned he should remember that he is the representative of the Medical Department and conduct himself accordingly. The sick bay should present a neat, clean appearance at all times. He should take pride in his personal appearance. Above all, he should prove himself to be steady, reliable, sober, conscientious, and willing. The continual display of these factors, plus a good knowledge of his duties and a desire to be helpful on his ship or station, will make a tour of independent duty interesting, and gain respect both for the individual and his corps.

GLOSSARY

The following are some common terms you, as a hospital corpsman, should know:

A

Abduction—movement away from the median line.

Abrasion—rubbing or scraping of skin or mucous membrane.

Abscess—localized collection of pus.

Absolute alcohol—that which contains not over 1 percent by weight of water.

Absorption—(1) the taking up of liquids by solids or of gases by liquids or solids; (2) the taking up of substances by the skin, mucous membrane, or certain vessels.

Achlorhydria—total absence of hydrochloric acid from gastric secretions.

Acid-fast—not readily decolorized by acids or other means when stained.

Acidosis—a depletion of the alkali reserve of the body; acid intoxication.

Acute illness—a disease having a short course.

Adduction—movement toward the median line.

Adenectomy—surgical removal of a gland.

Adenoma—benign tumor with glandlike structure.

Adhesion—abnormal joining of parts to each other.

Adipose—fatty.

Adjuvant—(1) assisting other remedies; (2) an auxiliary remedy.

Aerobic—living only in air or free oxygen.

Agglutination—collection into clumps of the cells distributed in a fluid.

Albumin—a protein found in nearly every animal and in many vegetable tissues, soluble in water, and coagulated by heat.

Albuminuria—presence of albumin in the urine.

Alkalosis—a condition of excessive alkalinity of body fluids.

Allergy—unusual or exaggerated sensitivity.

Alloy—a substance made up of two or more metals which fuse together when molten; as brass.

Alterative—a medicine used to modify nutritional processes so as to overcome morbid conditions.

Amoeba—a minute, one-celled protozoan animal organism; a single-celled nucleated mass of protoplasm which is constantly changing its shape by extending from its circumference processes of protoplasm called pseudopodia. By these processes it moves about and also absorbs nourishment.

Amphoteric—(1) having two opposite properties or characteristics, (2) possessing both acid and base characteristics.

Ampule—a small sealed glass capsule or vial containing a sterile solution of a drug.

Anaerobic—living and growing well without air or oxygen.

Analgesia—insensibility to pain.

Analgesics—medicines used to allay pain.

Anaphylaxis—an unusual or exaggerated reaction of an organism to foreign protein.

Anastomosis—the joining of two vessels.

Anemia—a condition marked by decrease in quantity of the blood or its quality, owing to a deficiency either in the number of red corpuscles or in the quantity of hemoglobin.

Anesthesia—loss of feeling or sensation, with or without the loss of consciousness.

Aneurysm—sac formed by the dilatation of the walls of an artery or vein and filled with blood.

Anhydrotic—medicines used to reduce perspiration.

Anomaly—a deviation from the normal standard.

Anorexia—lack or loss of appetite.

Anoxemia—deficiency of the oxygen content of the blood.

Anoxia—oxygen deficiency.

Antibiotic—harmful or destructive to life.

Anticoagulant—a substance which inhibits the coagulation of blood.

Antiemetic—medicines used to arrest vomiting.

Antiperiodics—medicines for relief of periodically recurring diseases.

Antipyretics—medicines used to reduce the body temperature.

Antispasmodics—medicines used for the relief of nervous irritability and minor spasms.

Antiseptic—a substance which will inhibit the growth of microorganisms without necessarily destroying them.

Anuria—absence of secretion of urine by the kidneys.

Anus—the lower end and outlet of the rectum.

Aperient—(1) mildly cathartic, (2) gentle purgative; (3) a laxative.

Aphagia—inability to swallow.

Appendectomy—surgical removal of the appendix.

Applicator—a tuft of cotton attached to a slender stick or wire.

Aqueous—watery; prepared with water.

Argyria—a permanent ashen-gray discoloration of the skin caused by the continued use of silver preparations.

Arrhythmia—irregularity in the rhythm of the heart beat.

Arthralgia—pain in a joint.

Arthritis—inflammation of a joint.

Articulate—(1) to unite by joints, or form a joint, (2) to speak clearly or distinctly.

Ascites—accumulation of fluid in the abdominal cavity.

Aspiration—the act of removing fluid or gas from a cavity.

Astringent—(1) causing contraction and arresting discharges, (2) an agent that arrests discharges.
Ataxia—lack of muscular coordination.
Atelectasis—partial collapse of the lung.
Atrophy—wasting away or diminution in size of a cell, tissue, organ or part.
Autoclave—an apparatus for sterilization by steam under pressure.
Axilla—the armpit.

B

Bacillus—(pl. bacilli) "little stick"—a rod-shaped body.
Bacteremia—presence of bacteria in the blood stream.
Bacteria—minute one-celled organism.
Bactericidal—destructive to bacteria.
Bacteriostat—an agent which stops the growth of bacteria.
Bal—British anti-lewisite—a compound developed as an antidote to certain war gases and used in case of poisoning by arsenicals or other metals.
Basal metabolism—the heat produced by the body when at complete physical and mental rest.
Bedsore—an ulcer caused by long continued pressure on some part of the body.
Benign—not malignant, not recurrent.
Bile—the yellow secretion from the liver.
Biopsy—inspection of a piece of tissue removed from a living subject.
Blood pressure—the force exerted by the blood against the walls of the blood vessels.
Bradycardia—abnormal slowness of the heart beat.
Bronchoscopy—examination of the bronchi through a bronchoscope.
Brownian movement—the dancing motion of minute particles suspended in a liquid.
Buffer—any substance in a fluid which tends to lessen the change in ion concentration (reaction).

C

Cachexia—a general wasting away of the body due to malnutrition or disease.
Calculus—a stone or abnormal concretion formed within the body, usually made up of mineral salts.
Capillary—pertaining to or resembling a hair.
Capillary attraction—the force which attracts the particles of a fluid into and along the caliber of a capillary tube.
Capillary pipette—a very fine hollow tube which fills by capillary attraction.
Cardiac depressants—medicines used to lessen the force and frequency of the action of the heart.
Cardiac stimulants—medicines which increase the force and frequency of the action of the heart.
Cardinal—of primary importance.
Carrier—an individual in whose body is harbored the organism of a disease, but who has no symptoms or signs of illness.
Catalyst—an agent which accelerates or otherwise affects a reaction in which it is not itself affected.
Cataract—an opacity of the crystalline lens or of the capsule of the eye.
Catheter—a tube used to introduce fluids into the body or to drain fluid from a body cavity.
Cellulitis—inflammation of cellular tissue.
Centrifugation—the process of separating the lighter portions of a solution, mixture, or suspension from the heavier portions by centrifugal force.
Centrifuge—a machine by which centrifugation is effected.
Cerebral depressant—medicines which lower the functions of the higher brain.
Cerebral excitant—medicines which increase the functional activity of the cerebrum without depression or suspension of the brain function.
Chafe—to irritate the skin by rubbing.
Cheyne-Stokes respirations—a type of breathing characterized by rhythmical variations in intensity.
Cholecyst—the gallbladder.
Cholecystography—X-ray examination of the gallbladder following administration of gallbladder dye.
Chromatin—the more stainable portion of the cell nucleus.
Chronic illness—a sickness of long duration.
Circumcision—removal of all or part of the foreskin of the penis.
Circumoral—around the mouth.
Clinical thermometer—an instrument for measuring body temperature.
Clostridium—genus of anaerobic, often parasitic, bacteria capable of producing disease in man.
Coagulation—the process of being changed into a clot.
Coalesce—to fuse or grow together.
Coaptation—the fitting together or adjustment of displaced parts, as of the ends of a fractured bone.
Coccus—(pl. cocci)—bacteria, which when fully developed and free are spherical.
Colectomy—excision of a portion of the colon or of the whole colon.
Colles's fracture—fracture of the lower end of the radius in which the lower fragment is displaced posteriorly.
Colostomy—formation of an artificial opening into the colon.
Coma—a state of complete loss of consciousness from which the patient cannot be aroused even by the most powerful stimulation.
Communicable disease—a disease caused by living organisms and transmissible from one person to another directly or indirectly.
Concurrent disinfection—immediate disinfection of infectious discharges or soiled articles throughout the course of a disease.
Congenital—borne with a person; existing at or before birth.
Contact—a person or animal known to have been in association with and exposed to an infected person or animal.
Contagious disease—see communicable disease.
Contamination—the introduction of impurities or disease-producing organisms.

Contraction—(1) a shortening, as of a muscle in response to a stimulus; (2) an abnormal shortening or shrinking due to disease.

Contusion—a bruise.

Convalescence—the process of recovery from illness.

Convulsion—a violent involuntary contraction or series of contractions of the muscles.

Corpuscle—(little body)—any small mass, organ, or body.

Corrosive—destructive, to the texture or substance of the tissues.

Coryza—an acute catarrhal condition of the nasal mucous membrane; a cold in the head.

Counterirritant—an agent used to cause a local reaction for the purpose of relieving a deep-seated inflammation.

Counterstain—a stain applied to render the effects of another stain more discernible.

Counting chamber—a space of definite thickness and provided with a ruled base into which blood dilutions may be placed for counting the number of blood corpuscles under the microscope.

Coverglass—a thin glass plate which covers a mounted microscopical object or culture.

Craniotomy—surgical incision into the cranium.

Crisis—the turning point of a disease.

Cross match—testing for compatibility of bloods by placing the donor's red cells in the recipient's serum and the recipient's red cells in the donor's serum.

Cycloplegic—drug causing paralysis of the ciliary muscle of the eye.

Cyst—any sac, normal or other, especially one which contains a liquid or semisolid.

Cystocele—hernial protrusion of the urinary bladder.

Cyanosis—blueness of the skin due to lack of oxygen in the blood.

D

Debility—lack or loss of strength.

Debridement—surgical removal of damaged or infected tissue from a wound.

Decolorization—to free from color; to bleach.

Decubitus ulcer—a bedsore.

Dehydration—the removal of water from a substance.

Delirium—disordered mental state with excitement and illusions.

Deodorants—substances which destroy or hide foul odors.

Diabetes—a disease caused by failure of the body to produce sufficient insulin to regulate carbohydrate metabolism.

Diagnosis—the art of distinguishing one disease from another.

Diaphoresis—profuse perspiration.

Diaphoretics—medicines which produce increased perspiration.

Diastolic—pertaining to the period of dilatation of the heart. The heart at rest.

Differential count—a count of white blood cells whereby the percentage of different types of leukocytes is tabulated.

Differential stain—one in which two or more dyes are used in order to differentiate organisms by color contrast.

Diplococcus—spherical bacteria which occur in pairs.

Disease—any departure from the state of health.

Disinfectant—any chemical substance that destroys micro-organisms.

Disinfectant—(1) an agent that destroys disease-pro-producing substances or organisms; (2) a germicide or bacteriocide.

Disinfection—killing of pathogenic organisms or agents by chemical or physical means directly applied.

Dislocation—the displacement of a part.

Distention—swelling of an organ or part of the body due to the presence of excess fluid or gas.

Diuretics—medicines which increase the secretion of the urine.

Douche—a stream of water directed against a surface or into a cavity.

Droplet—a small quantity of moisture suspended in air; expelled into the air by coughing, sneezing, hawking, laughing, loud talking.

Dyspnea—labored or difficult breathing.

E

Ecchymosis—discoloration of the skin due to the escape of blood from a vessel into the tissue.

Edema—swelling due to the collection of fluid in tissues.

Efficacy—(1) the ability to produce desired results; (2) effective action.

Effusion—the escape of fluid into a part or tissue.

Egocentric—self-centered.

Embolus—a blood clot or other plug such as fat, air, bacteria, or tissue brought by the blood current from a distant vessel and forced into a smaller one causing an obstruction to the circulation.

Embrocations—liquid medicines for external use.

Emesis—the act of vomiting.

Emetic—(1) producing vomiting; (2) an agent which produces vomiting.

Empyema—the accumulation of pus in a cavity of the body.

Endemic—(applied to a communicable disease)—present more or less continuously in a region.

Endoscopy—inspection of any cavity of the body by means of an endoscope.

Enervation—lack of vigor and nervous energy.

Enuresis—involuntary discharge of urine.

Eosin—a rose-colored stain or dye.

Eosinophil—a structure or cell readily stained by eosins.

Epidemiology—the study of all factors causing epidemic diseases.

Epidemic—(applied to communicable disease)—attacking simultaneously a large number of people in a community.

Epistaxis—a nosebleed.

Erythrocyte—a red blood corpuscle.

Eschar—a slough or crust of dead tissue, especially that occurring after a burn.

Escharotics or caustics—medicines which destroy the tissue to which they are applied.
Ethanol—ethyl alcohol.
Excrete—to throw off, as waste matter, by normal discharge.
Excruciating—causing extreme suffering.
Expectorants—medicines which increase bronchial secretions.
Expectoration—discharge of material from the air passage by spitting or coughing.
Extravasation—a discharge or escape, as of blood, from a vessel into the tissues.
Exudate—an excess of fluid and cells present in or issuing from tissues, especially as a result of inflammation or trauma.

F

Fauces—the passage between the mouth and the pharynx.
Feces—waste material discharged from the bowels.
Fever—elevation of body temperature above normal.
Fibrin—the essential portion of the blood clot.
Filtrable virus—living organism capable of passing through pores of a porcelain or other type filter which hold back ordinary bacteria.
Fissure—any cleft or groove.
Fistula—a sinuous ulcerated tract often leading to an internal hollow organ.
Flatulence—distention of the stomach or intestines with gas or air.
Fluctuation—a wavelike motion, as that produced by vibration of a body fluid.
Fomentation—treatment by warm and moist applications; also the substance thus applied.
Forceps—an instrument used to grasp an object; tweezers.
Fowler's position—position of patient with the head of his bed elevated 18 to 20 inches.
Furuncle—a boil.
Fusiform—spindle-shaped.

G

Gametocyte—the sexual cell of malaria in the blood stream.
Gangrene—death of tissues.
Gastrectomy—removal of whole or part of the stomach.
Gastritis—inflammation of the stomach.
Gastroenterostomy—creation of an artificial passage between the stomach and the intestines.
Gage—a standard of measurement.
Gauze—thin, light, open meshed fabric, used in making surgical dressings.
Gavage—feeding by means of a tube passed into the stomach.
Gland—an organ that produces an internal or external secretion.
Glycosuria—the presence of an abnormal amount of sugar in the urine.
Gram-negative—bacteria which lose the stain or are decolorized by alcohol in Gram's method of staining.
Gram-positive—bacteria which retain the stain in Gram's method of staining.

H

Heliotherapy—the treatment of disease by exposing the body to the sun's rays.
Helminth—an intestinal worm or wormlike parasite.
Hemacytometer—an instrument used in counting the blood corpuscles.
Hematemesis—the vomiting of blood.
Hematuria—discharge of bloody urine.
Hemoglobin—coloring matter of red blood corpuscles.
Hemolysis—the liberation of hemoglobin.
Hemometer—an instrument for measuring the hemoglobin content of the blood.
Hemoptysis—the spitting of blood.
Hemorrhage—escape of blood from blood vessels.
Hemorrhoid—a vascular tumor of the rectal mucous membrane.
Hemostat—an instrument or medicine for checking hemorrhage.
Hemostatics—medicines used to arrest hemorrhage.
Hernia—protrusion of a loop of tissue or organ through an abnormal opening.
Herpes—skin disease marked by clusters of small vesicles.
Hordeolum—a sty.
Hyperemia—presence of excess blood in any part of the body.
Hyperglycemia—excess of sugar in the blood.
Hyperpyrexia—abnormally high body temperature.
Hypertrophy—enlargement or overgrowth of an organ or part.
Hypodermic—under the skin.
Hypnotic—an agent which induces sleep—a somnifacient.
Hypoglycemia—a deficiency of sugar in the blood.
Hypnotics—medicines which produce sleep without narcotic effects.

I

Icterus—yellowness of the skin, eyes and secretions, due to the presence of bile-pigments in the blood; jaundice.
Idiosyncrasy—a habit or quality of body or mind peculiar to any individual; also a peculiar susceptibility to some drug or other agent.
Immunity—the power which a living organism possesses to resist or overcome infection.
Incontinent—inability to restrain a natural discharge.
Incubation period—the time that elapses from exposure to a disease until the first symptoms of that disease develop.
Induration—process of becoming hard.
Infection—invasion of the tissues of the body by living pathogenic organisms in such a way as to favor their growth and permit their toxins to injure the tissues.
Infectious disease—see communicable disease.
Inflammation—reaction of the tissues to irritation or injury.
Inhalation—the drawing of air or other vapor into the lungs.
Inoculating loop—a special wire loop, usually platinum, used for transferring bacterial growths or infectious material to culture media.

Inoculation—the injection of a substance into the body for the purpose of diagnosing, preventing, or treating a disease.
Iris diaphragm—an attachment on the microscope condenser which controls light in the manner of a camera shutter.
Irrigation—washing by a stream of water or other liquid.
Isolation—the separation of an infected person from direct or indirect contact with other persons.
Isolation technique—methods developed in the care of a patient with a communicable disease which will confine the disease to the patient and protect personnel and other patients from contracting his disease.
Isotonic—having a uniform tonicity or tension. Having the same osmotic pressure on opposite sides of a membrane.

K

Keratoplasty—plastic surgery of the cornea.

L

Laceration—a wound made by tearing.
Lactation—the secretion or formation of milk.
Laminectomy—removal of the posterior arch of a vertebra.
Laparotomy—surgical incision into the abdominal cavity.
Latent—(1) hidden or concealed from view; (2) potential.
Lethal—deadly, or causing death; fatal.
Leukocytosis—an increase in the number of white corpuscles in the blood.
Ligature—thread or wire for tying a part.
Liter—the unit of capacity in the metric system (1.056 quarts).
Lens paper—a special grade of fine Japanese tissue for cleaning lenses.
Leukemia—a fatal disease characterized by an increase in white blood cells.
Leukocyte—a white blood corpuscle.
Leukopenia—a decrease in the number of leukocytes in the blood.
Lysis—the gradual decline of a disease or the gradual return to normal.

M

Macroscopic—visible with the unaided eye or without the microscope.
Malignant—virulent and tending to go from bad to worse.
Mastoidectomy—excision of mastoid cells.
Medical aseptic technique—see isolation technique.
Melena—the passage of dark tarry stools stained with altered blood or blood pigments.
Meniscus—the surface of a liquid column.
Menorrhea—normal process of menstruation.
Metastasis—transfer of disease from one organ or part to another not directly connected with it.
Micro-organism—any minute animal or plant.
Microscopic—pertaining to or visible only by the aid of the microscope.

Millimeter—1/1000 liter.
Modality—a method of application of, or the employment of, any therapeutic agent; limited usually to physical agents.
Morbidity—a disease, sickness.
Morphology—the science of the forms and structures of organized beings.
Mortality—death.
Motility—the ability to move spontaneously.
Motor depressants—medicines which lower the functional activity of the spinal cord and motor apparatus.
Motor excitants—medicines which increase the functional activity of the spinal cord and motor apparatus.
Myalgia—pain in a muscle or muscles.
Mydriasis—extreme dilation of the pupil of the eye.
Mydriatics—medicines which cause dilation of the pupil of the eye.
Myotics—medicines which cause contraction of the pupil of the eye.
Myxedema—a disease due to hypofunction of the thyroid gland, characterized by swelling and dryness of skin, sluggish mental activity, and lowered basal metabolism.

N

Nausea—a tendency to vomit.
Nebulizer—a device for throwing a spray; an atomizer.
Necrosis—death of tissue in a limited area.
Neoplasm—a new and abnormal formation of tissue; a tumor.
Nephritis—inflammation of the kidney.
Nephrectomy—surgical removal of the kidney.
Nephrosis—any disease of the kidney, especially degenerative lesions of tubules without inflammation.
Neuropsychiatry—that branch of medicine that deals with diseases of the nervous system and mental disorders.
Neutrophil—stainable by neutral dyes.
Nocturia—excessive urination at night.
Nucleus—spheroid body within a cell, forming the essential and vital part.

O

Occlusion—state of being closed.
Occupational therapy—the employment of some occupation in the treatment of disease.
Oil immersion—actual contact with a drop of oil on a slide of a particular microscope objective.
Olecranon—the curved process of the ulna which forms the bony prominence at the elbow.
Ophthalmoscope—an instrument for examining the eye.
Organism—any individual animal or plant.
Orthopedics—the science dealing with the study and treatment of conditions affecting the bones and muscles of the body.
Orthopnea—inability to breathe except in an upright position.
Osmosis—the passage of a fluid through a membrane.
Osteomalacia—abnormal softening of bone, caused by a lack of lime salt or calcium.
Otoscope—an instrument for examining the ear.

P

Pandemic—(applied to communicable disease)—occurring in marked proportions throughout a large region.

Paralysis—a loss of motion or sensation in a living part or member.

Parasite—any organism that subsists on other living beings.

Parenteral—not through the alimentary canal.

Pathogen—any organism capable of producing disease.

Pathogenic—giving origin to disease or to morbid symptoms.

Peripheral—pertaining to the outer boundary or surface of a boundary.

Peritonitis—inflammation of the peritoneum.

Peristalsis—the involuntary, wormlike contraction of the muscle fibers in the intestines by which the contents of the intestines are propelled forward.

Phagocyte—any cell that ingests microorganisms or other cells and substances.

Phlebotomy—incision into a vein.

Physiologic—normal, not pathologic.

Physiologic salt solution—one that contains 0.9 percent of salt. It resembles most of the animal fluids in action, density and osmotic pressure.

Pipette—a glass tube used in handling small quantities of liquid or gas.

Pleurisy—inflammation of the pleura.

Precordium—the region over the heart and stomach; the epigastrium and lower part of the chest.

Prognosis—a forecast as to the probable result of an attack of a disease.

Progressive motility—the ability to move spontaneously with apparent purpose.

Protoplasm—the only known form of matter in which life is manifested.

Prophylaxis—a procedure carried out to prevent a disease.

Prostatectomy—surgical removal of the prostate gland.

Protozoan—the lowest division of the animal kingdom.

Pruritus—severe or intense itching.

Psoriasis—a skin disease characterized by the formation of scaly red patches on the extensor surfaces of the body.

Ptosis—prolapse of an organ or part.

Pulpefaction—conversion into pulp.

Purgative—cathartic; causing evacuation from the bowels.

Purulent—consisting of or containing pus.

Pus—a liquid inflammation product made up of leukocytes and thin fluid.

Pyogenic—producing pus.

Pyrexia—to be feverish; abnormal elevation of the body temperature.

Q

Quadriplegia—paralysis of all four limbs.

Qualitative—pertaining to quality.

Quantitative—pertaining to quantity.

Quarantine—the limitation of activity of individuals who have been exposed to a communicable disease to protect others from exposure.

R

Rale—any abnormal respiratory sound heard in auscultation and indicating some pathological condition.

Rapport—a relation of harmony and accord between patient and physician, nurse, corpsman.

Refractory—resisting, or not yielding readily to treatment.

Resection—excision of a portion of an organ.

Resistance to disease—relative insusceptibility to disease.

Respiration—the act by which air is drawn into and expelled from the lungs (including inspiration and expiration).

Resuscitation—the restoration to life or consciousness of one apparently dead.

Retention—the persistent keeping within the body of matter normally excreted.

Rigor mortis—the rigidity or stiffening which follows after death.

S

Seborrhea—a functional disturbance of sebaceous glands, with increase in amount, or change in quality, of their secretion.

Secretion—(1) the process or function of separating various substances from the blood; (2) any secreted substance.

Sedimentation rate—the degree of rapidity with which the red cells sink in a mass of drawn blood.

Semilunar—shaped like a crescent or half moon.

Septicemia—a condition due to the presence of pathogenic bacteria and the associated poisons in the blood.

Serum—the clear portion of any animal liquid separated from its more solid elements.

Sialogogues—medicines used to increase the flow of saliva.

Solute—a substance dissolved in a solution.

Solvent—a liquid that dissolves or is capable of dissolving.

Sordes—the dark brown, foul matter which collects on the lips and teeth of a patient with a protracted low fever.

Spasm—a sudden, violent involuntary contraction of a muscle or a group of muscles.

Spatial—pertaining to space.

Specific gravity—the weight of a substance compared with that of an equal volume of another substance taken as a standard.

Specimen—a sample or small quantity of a substance which shows the kind and quality of the whole, such as a blood or urine specimen.

Sphygmomanometer—an instrument for determining the blood pressure in the arteries.

Sporadic—(applied to communicable disease) occurring in scattered or occasional instances.

Sporulation—the production of spores.

Sprain—wrenching of a joint with partial rupture of its attachments.

Sputum—saliva mixed with mucus and other substances from the respiratory tract.
Staining characteristics—the manner in which organisms react to staining.
Staphylococcus—a genus of bacteria made up of spherical cells in irregular groups.
Stenosis—narrowing or stricture of a duct or canal.
Sterilization—the process of freeing a substance of microorganisms.
Strain—an injury to muscles resulting from tension produced by overuse or misuse. To filter.
Streptococcus—spherical bacteria whose cells occur in chains.
Stricture—abnormal narrowing of a duct or canal.
Sudorific—an agent that causes sweating. A diaphoretic.
Supernatant—floating on the surface or on top of something.
Suppression—sudden stoppage of a secretion, excretion or normal discharge.
Suppuration—the formation of pus.
Surgical aseptic technique—methods developed in the care of a patient with a wound which will protect the patient from possible infection carried by the air, the worker or other patients.
Symptoms—any evidence of disease.
Synchronous—occuring simultaneously or at the same time.
Synergistic—acting with another, as a medicine or a muscle.
Systolic—pertaining to the contraction of the heart. The heart at work.

T

Tachycardia—excessively rapid heart beat.
Taeniacides—medicines which kill tapeworms.
Temperature—the degree of sensible heat or cold.
Tenesmus—straining; especially ineffectual and painful straining at stool or in urination.
Tenorrhaphy—surgical repair of tendons.
Tenosynovitis—inflammation of the tendon sheaths.
Teratoma—a tumor containing fetal remains such as teeth, hair, or other organs.
Terminal disinfection—disinfection or destruction of infectious material after the patient recovers or succumbs to a communicable disease.
Thoracentesis—surgical puncture or tapping of the chest wall.
Thrombus—a plug or clot in a vessel remaining at the point of formation.
Thyroidectomy—surgical removal of the thyroid gland.
Topical—pertaining to a particular area.
Tonsillectomy—surgical removal of the tonsils.
Toxemia—a general intoxication due to the absorption of bacterial products into the blood stream.
Toxic—poisonous; pertaining to, due to, or of the nature of, a poison.
Traction—the act of drawing or pulling.
Trauma—a wound or injury.
Tubercle—a nodule in the skin; a term applied to small rounded nodules produced by the mycobacterium of tuberculosis.
Tumor—abnormal swelling; enlargement; a neoplasm.

U

Ulcer—an open sore on the skin or mucous membrane, usually with suppuration, causing gradual deterioration and death of tissues.
Unconscious—insensible, unaware of self or environment, unable to receive or respond to stimuli.
Uremia—a toxic condition caused by retention in the blood of substances normally excreted by the kidneys in the urine.
Urinalysis—chemical or microscopic analysis of urine.
Urinometer—an instrument for determining the specific gravity of urine.
Urticaria—hives or rash due to allergy.

V

Vacuole—any space or cavity formed in the protoplasm of a cell.
Vector—a carrier, especially an animal host that carries disease germs from one individual to another.
Venipuncture—the surgical or therapeutic puncture of a vein.
Vertigo—a sensation of dizziness.
Vesicle—a small blister or sac containing fluid.
Virulence—the power of an organism to overcome the defenses of the host.
Virulent—exceedingly harmful.
Virus—a living virulent cause of disease.
Viscera—large organs within the abdominal cavity.
Void—to cast out, as waste material, to urinate.
Vomitus—matter expelled from the stomach through the mouth.

INDEX

NOTE.—*—Illustrated

B

F

Q

R

U